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ARMY COUNTERMINE MOBILITY EQUIPMENT SYSTEM (ACMES)

by

David A. Vaughn
and
Robert Felts

November 1971



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U. S. ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT CENTER
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November 1971

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**The Commanding Officer
U. S. Army Mobility Equipment Research and Development Center**

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SUMMARY

The mechanism of mobility kills of combat, armored, tracked vehicles by harassment mining is examined in a total-system context. Measures of effectiveness are postulated, and alternative approaches are synthesized. These alternative approaches are then evaluated and ranked on an effectiveness scale. From the visible rationale thus developed, conclusions are derived and future relevant tasks are defined.

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ARMY COUNTERMINE MOBILITY EQUIPMENT SYSTEM (ACMES)

I. INTRODUCTION

The use of harassment mines against mobility equipment is highly resource-effective from the viewpoint of the mine layer. This condition arises from the practical difficulties of accomplishing effective detection and then neutralization under field combat conditions. Relatively small, simple explosive charges set off by contact, delay, influence, or command fuzing will almost certainly break the vehicle track and thus inflict a mobility kill. There is also a high probability that additional damage from the blast will be limited to the first and second road wheels of the vehicle, while the engine, power train, weapons, crew, and remaining wheels will generally be intact and operable. But, in spite of the relatively minor structural damage that is incurred from a mine hit, the critical function of mobility is lost. After loss of mobility, the vehicle and crew then become highly vulnerable to destruction by artillery, antitank weapons, and sappers.

This study begins with the proposition that future improvements in the theory and practice of mine detection and mine neutralization may not influence to any significant extent the enemy resource effectiveness of harassment mining. From this proposition, it is postulated that a balanced Army Countermine System should also include a capability to maintain mobility independent of the detection and neutralization limitations that may be imposed upon the total system. This approach has the potential to reduce mobility losses where little or no detection and neutralization capability per se is present. Then, in the event that detection and neutralization capabilities become significantly improved, effective countermine systems could be rapidly tailored to meet a variety of threats and threat combinations.

The general concept for a countermine total system is outlined in Fig. 1. This approach to a total countermine system emphasizes the maintenance of vehicle mobility in the "press on" mode. With this concept, neutralization either blindly or after detection and bypassing after detection are considered to be functions of other subsystems.

II. APPROACH TO THE PROBLEM

The top-level function flow diagram presented in Fig. 2 depicts the total countermine system (vehicular) as a series of optional functions and outcomes. The heavy line on this diagram indicates the thrust of the study where a mine is encountered and a hit is incurred. The relationships do not imply that detection and neutralization were employed but only that a damage-producing hit was taken by the vehicle.

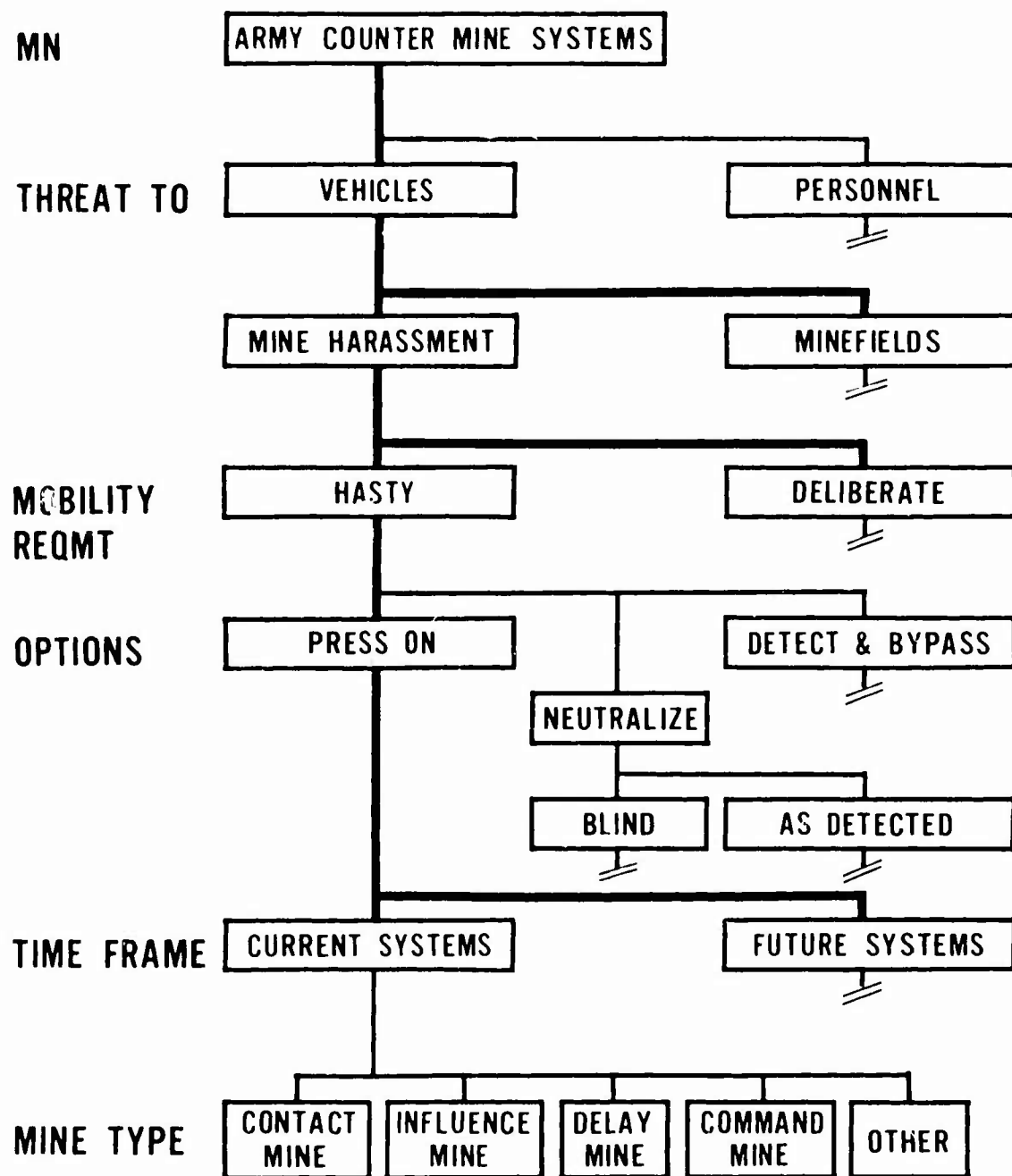


Fig. 1. Countermine total-system concept.

FUNCTION FLOW BLOCK DIAGRAM TOP LEVEL

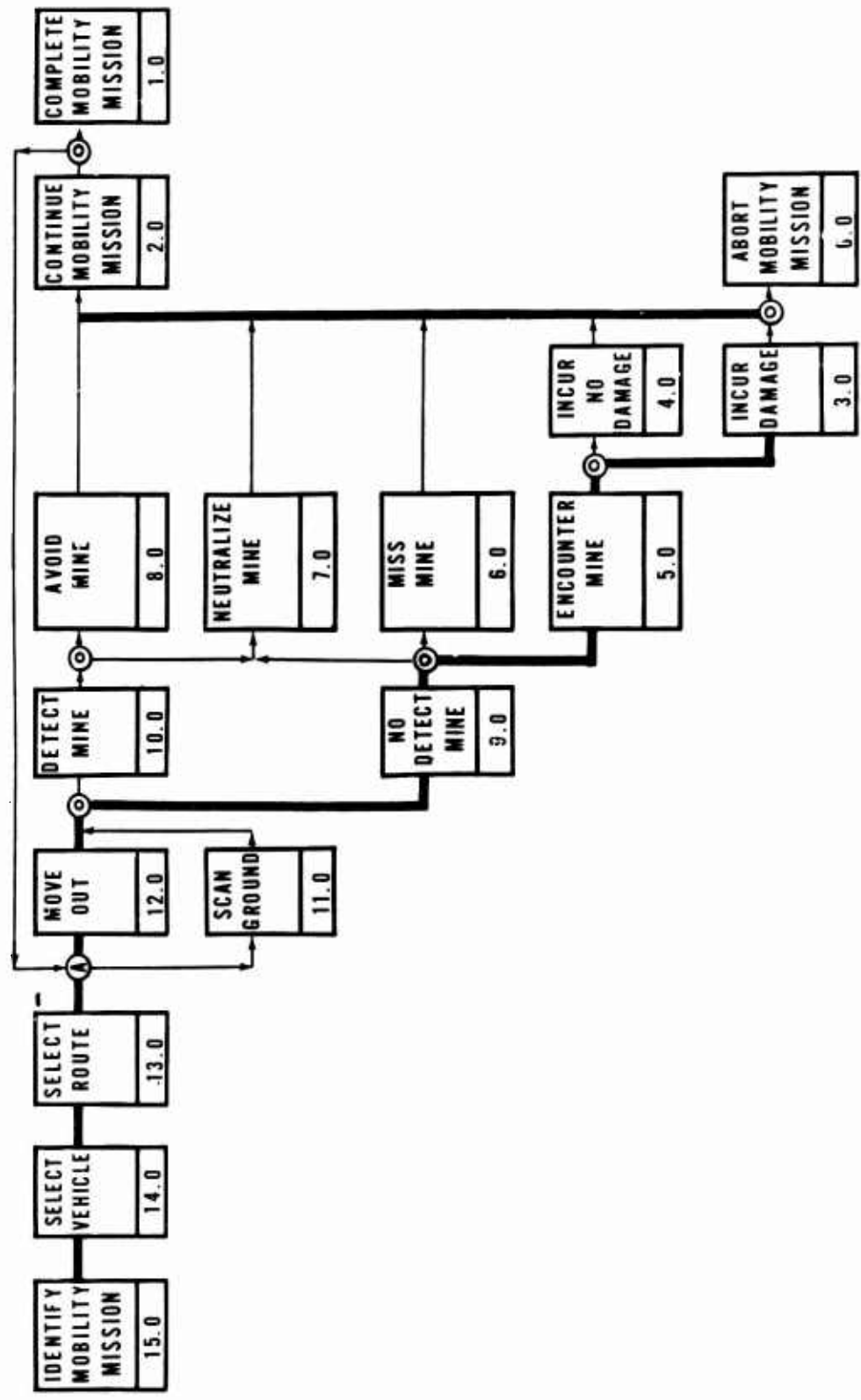


Fig. 2. Vehicle countermine system—function flow block diagram.

This diagram provides a degree of perspective to the system behavior and establishes a framework for some tentative observations:

a. If function 11.0, "Scan Ground," imposes a penalty upon vehicle mobility by necessitating a slow advance, then the threat system effectiveness is high. In some situations, scanning activity might also cause preoccupation and distraction from the prime mission.

b. If function 7.0, "Neutralize Mine," is performed only after function 10.0, "Detection," then function 2.0, "Continue Mobility Mission," is a conditional probability ($P_{\text{Detect}} \times P_{\text{Neutralize}} = P_{\text{Continue}}$) that has severe state-of-the-art limitations. If function 7.0, "Neutralize Mine," is performed without first detecting the mine, i.e., blindly, then P_{Continue} would be higher and more favorable but costly in time, material, and other resources. The threat-system effectiveness would be reduced sharply, however, if blind neutralization can be accomplished rapidly and without a mobility penalty.

c. The idea of taking a mine hit with no loss or serious degradation of vehicle mobility (function 5.0 to function 4.0) is highly attractive, but this leads directly to the historical trade off between vehicle mobility and vehicle armor. Each specific armored vehicle design represents a compromise solution and will remain so until ballistic protection can be obtained without inert weight.

This problem is much too complex for discussion here; so, for simplicity, it will be assumed that armored vehicles in the current inventory are optimum in regard to mobility vs armor for their intended mission.

d. The sequence from function 5.0, "Encounter Mine," to function 3.0, "Incur Damage," to function 2.0, "Continue Mobility Mission," should be examined in detail. With this objective, the outcomes of function 3.0, "Incur Damage," are shown in Fig. 3. From this, the problem may be stated.

III. STATEMENT OF THE PROBLEM

Loss of armored vehicle mobility due to encounter with a mine and subsequent destruction of critical mobility components.

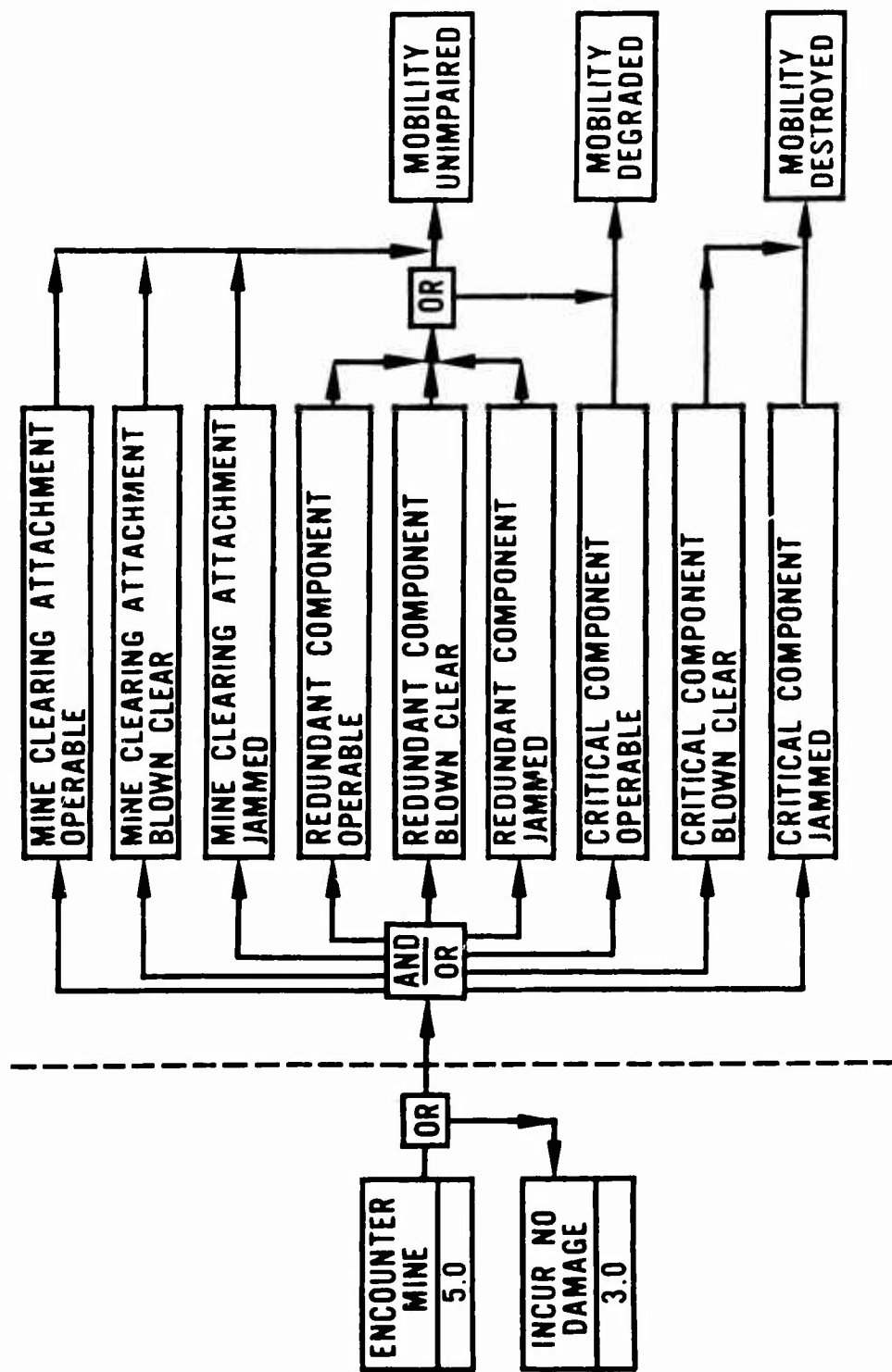


Fig. 3. Outcomes of function 3.0, "incur damage."

IV. STATEMENT OF THE MATERIEL NEED (MN)

Provide combat, armored, tracked vehicles with the capability to maintain mobility after encounter with a mine. Assume that mobility after the encounter can be ____% of the original mobility.

V. ANALYSIS OF DATA

Before the synthesis of alternative approaches is begun, two tasks must be accomplished to provide an information base:

1. Identification and assessment of the credible modes of mobility impairment or mobility loss due to mine damage.
2. Identification of measures of effectiveness that will assist in the evaluation of alternative approaches to the problem.

For the identification and assessment of modes of mobility impairment due to a mine encounter, the Battle Damage Assessment Reporting Program (BDARP) from the Republic of Viet Nam for June 1969 to July 1970 is particularly helpful.

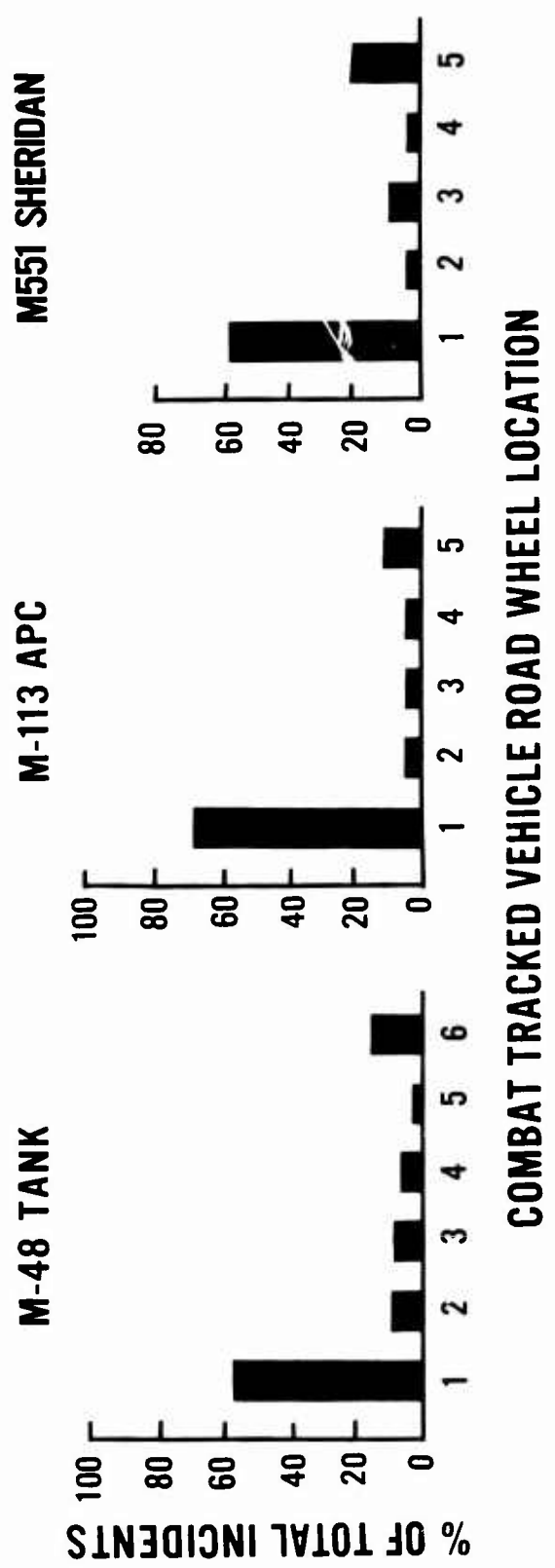
As a part of the countermine study, the BDARP individual incident data sheets were studied for mine-hit location and hit severity on combat, tracked vehicles. These data encompassed:

M-48 Tank incidents	80*
M-113 APC incidents	230*
M-551 Sheridan incidents	70*

Hit location for these incidents is presented in Fig. 4. The horizontal axis depicts road-wheel location, from vehicle front to rear, and the vertical axis expresses the incidents with a specific wheel hit as a percentage of the total number of incidents. The chart shows that about 70 percent of all vehicle hits occur on the first and second road wheels. The percentage is slightly higher when rear-wheel hits are regarded as first-wheel hits when the vehicle is backing up.

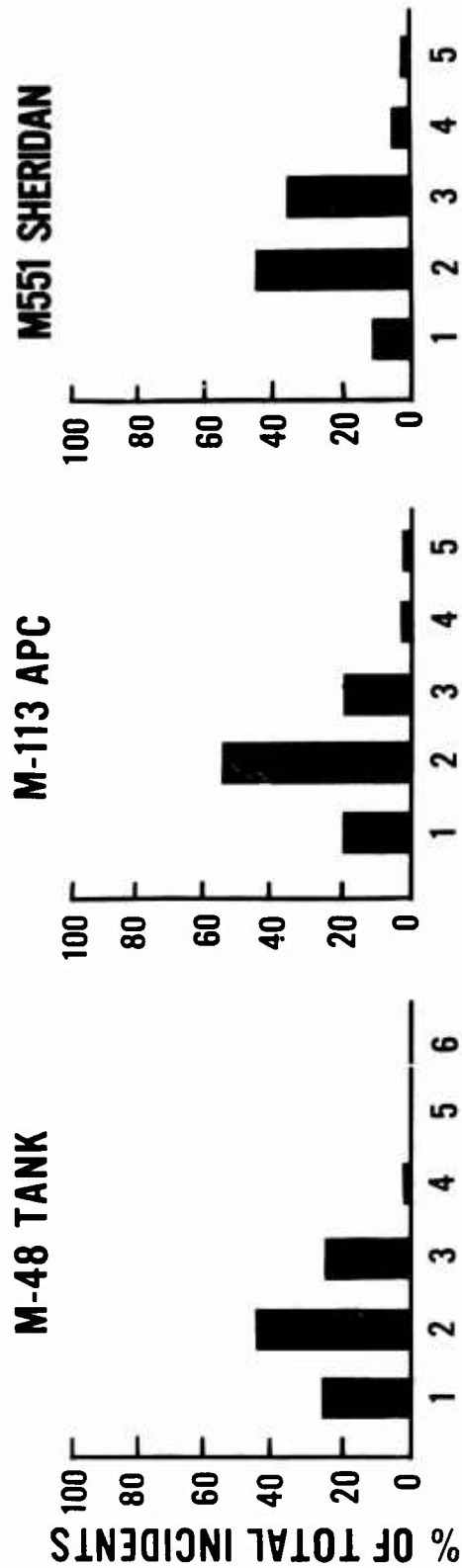
Hit damage for these incidents is presented in Fig. 5. The horizontal axis depicts the number of road wheels damaged or removed by a single hit, and the vertical axis

*Approximate numbers



* DATA SOURCE: BATTLE DAMAGE ASSESSMENT REPORTING PROGRAM (BDARP)-JUNE 69-JULY 70,
REPUBLIC OF VIETNAM

Fig. 4. Mine hit location on combat, tracked vehicles.



NUMBER OF ROAD WHEELS DAMAGED AND/OR REMOVED FROM VEHICLE

NOTE: IN OVER 90% OF ALL MINE INCIDENTS INCLUDING COMBAT TRACKED VEHICLES, THE TRACK IS DAMAGED OR BROKEN AND THE SUSPENSION IS DAMAGED RESULTING IN MOBILITY KILL ON THE VEHICLE.

*** DATA SOURCE: BATTLE DAMAGE ASSESSMENT REPORTING PROGRAM (BDARP) - JUNE 69- JULY 70, REPUBLIC OF VIETNAM**

Fig. 5. Single mine hit damage to combat, tracked vehicles.

again expresses the percentage of total incidents. In more than 90 percent of all mine incidents involving tracked vehicles, the track is either broken or thrown off.

Photographs from typical BDARP reports are reproduced as Figs. 6, 7, and 8. The corresponding BDARP raw reports are reproduced in Appendix A. Summarizing, these data support the conclusion that harassment mining in the SEA environment produces a mobility kill by removing or destroying track and the first two road wheels in 60 to 70 percent of all incidents.

VI. MEASURES OF EFFECTIVENESS

The measures of effectiveness (MOE) by which the degree of attainment of system goals is evaluated are postulated as follows:

- 1. **Mobility before Hit.** This MOE is based upon the position that the counter-mine system should not impose a penalty upon the mobility of the vehicle. If, for example, the vehicle has a capability to move at 20 mph in a given environment, the countermine system should also function effectively at 20 mph. Otherwise, the mine is undesirably resource effective from the time standpoint.
- 2. **Mobility after Hit.** This MOE is based upon the belief that the mobility vehicle should have the capability to take a moderately sized hit and still be able to either move to shelter or continue the mission. The capability to continue the mission after loss of two road wheels and corresponding track on one side or the other is, of course, a prime objective of this study. This MOE may be regarded as an effort to again avoid the armor weight versus mobility trade off.
- 3. **Resistance to a Mobility Kill.** The purpose of this MOE is to place a premium upon alternative concepts that will reduce the enemy benefits of minefields and harassment mining when used against armored, tracked, combat vehicles.
- 4. **Cost Exchange Ratio (CER).** The word "cost" in the CER refers to the resource or resources most valued by the blue and red forces. It may encompass money, time, men, political impact, and other values. For example:

Minefield Installation Time (RED)	0.01 HR/M ²
Minefield Location Time (BLUE)	0.09 HR/M ²
Minefield Clearing Time (BLUE)	0.12 HR/M ²

Then: $\frac{\text{Time to Install (RED)}}{\text{Time to locate and clear (BLUE)}} = \frac{0.01}{0.09 + 0.12} = \frac{1}{21}$

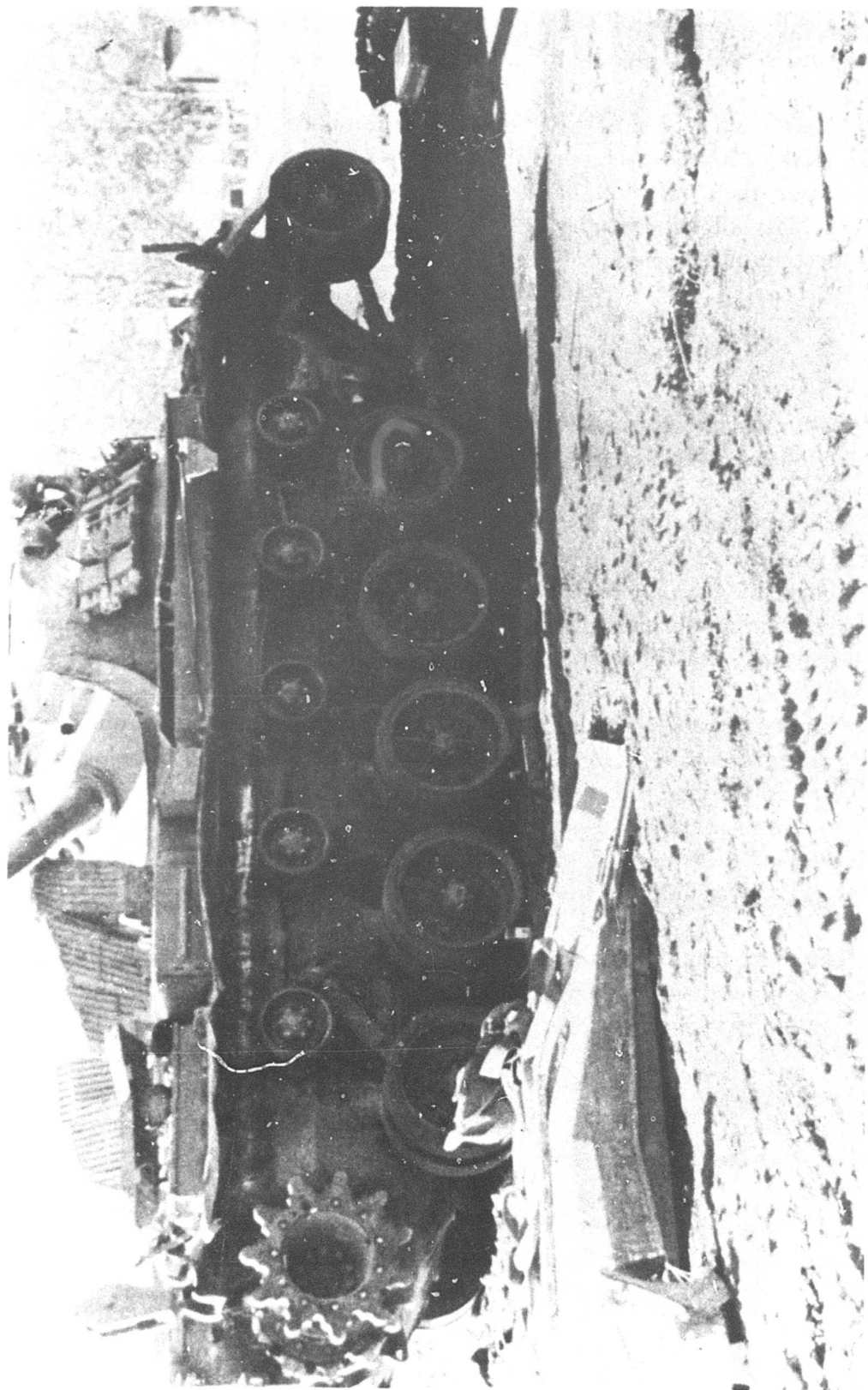
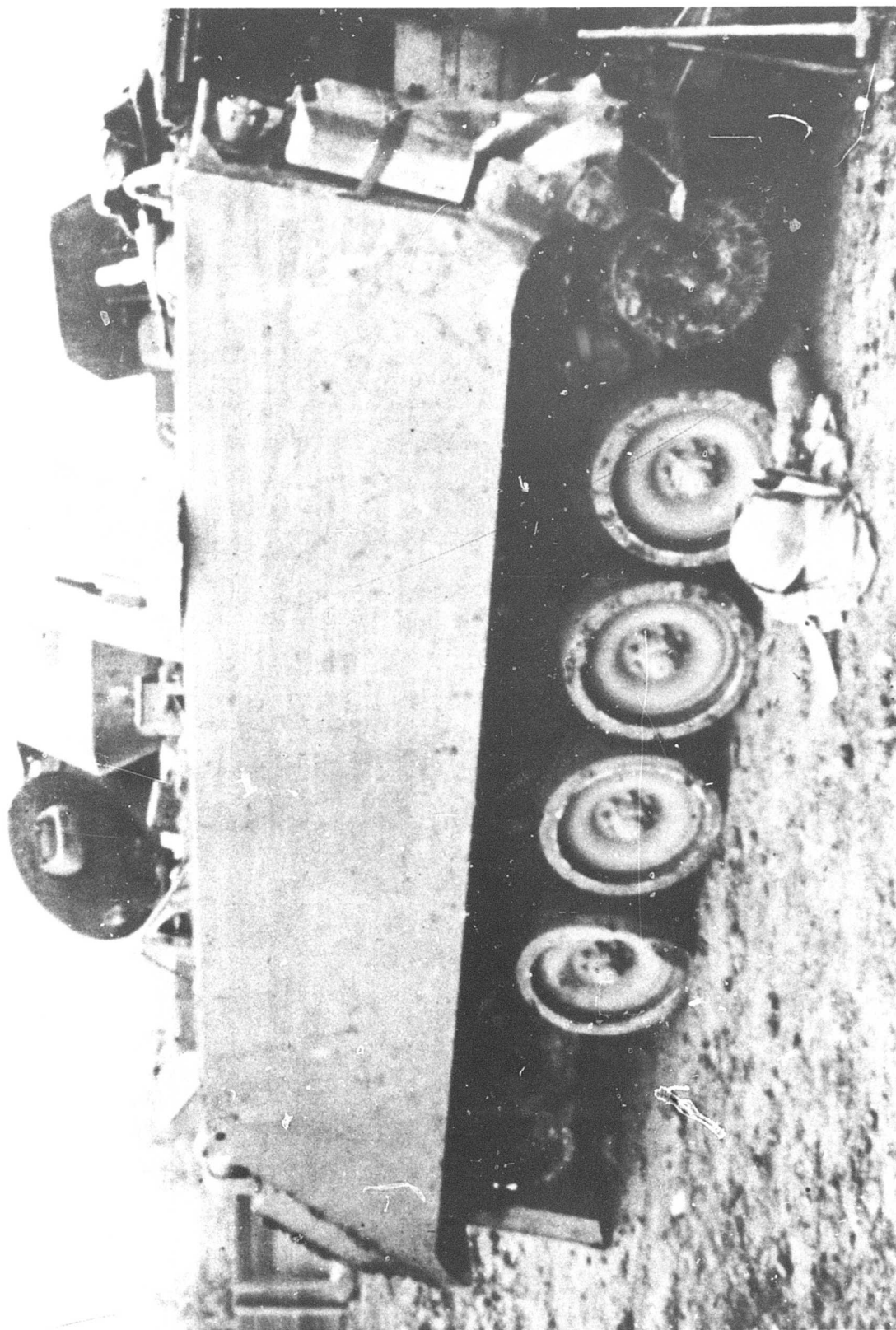


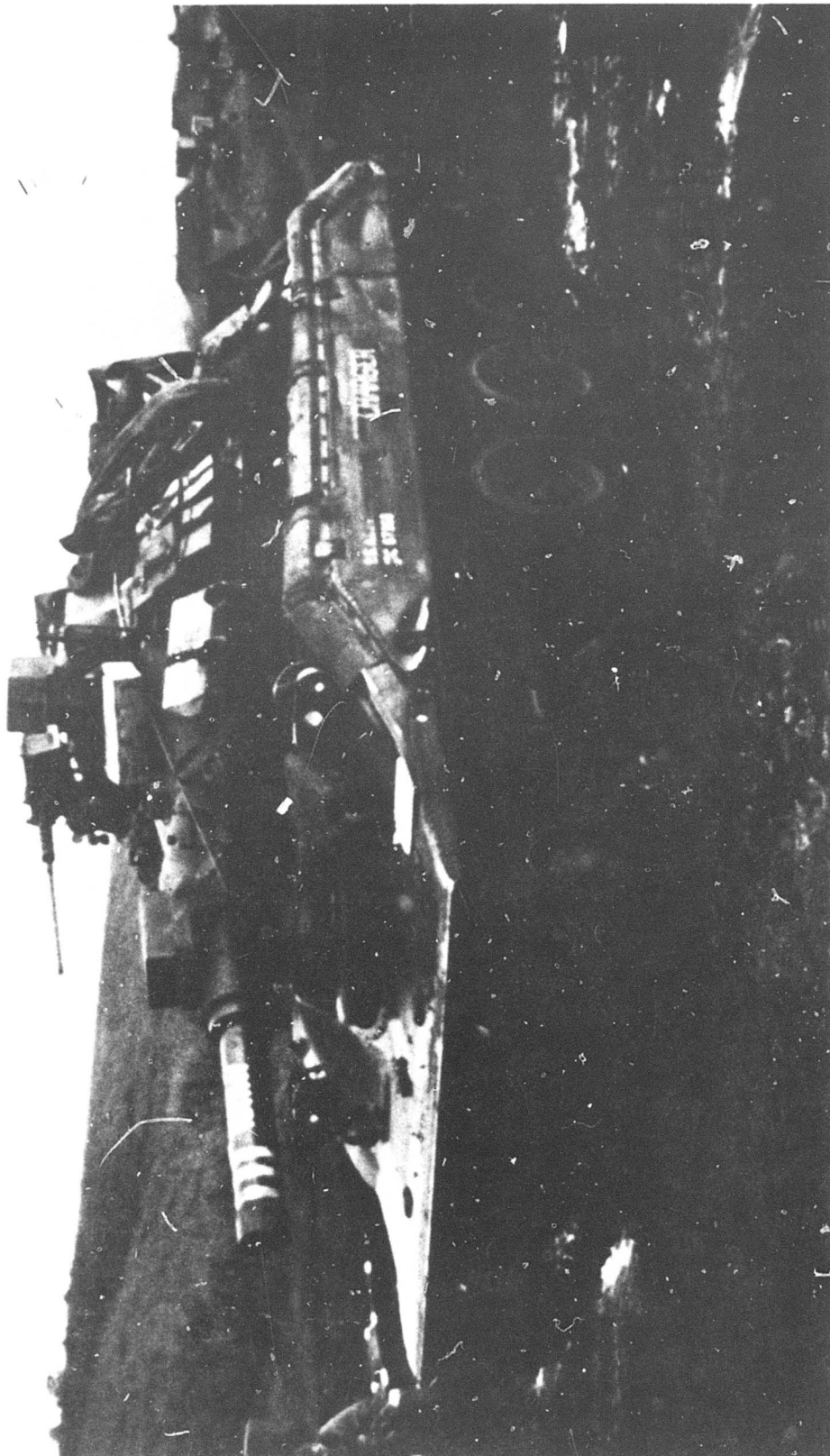
Fig. 6. Battle damage assessment reporting program: tank hit.

T12732



T12736

Fig. 7. Battle damage assessment reporting program: armored personnel carrier hit.



T12741

Fig. 8. Battle damage assessment reporting program: Sheridan vehicle hit.

Then, the cost exchange ratio of 1/21 indicates a time-effective advantage of mining. For another example of the CER concept for measuring effectiveness, consider a red mine costing \$50.00 destroying a blue vehicle costing \$500,000.00.

$$\text{CER} = \frac{\text{Red Cost}}{\text{Blue Cost}} = \frac{50}{500,000} = \frac{1}{10,000}$$

5. **Other Factors.** "Effectiveness" is generally defined as the product of availability, dependability, and capability. In this initial study, capability is being emphasized and consideration of availability, dependability, and CER is deferred. The CER concept, schedule, and other cost considerations will get more attention in future studies especially where the impact of red counter-countermeasures upon the countermine system is examined.

VII. ALTERNATIVE APPROACHES

In this initial study, 17 conceptual approaches have been selected for examination and comparison. The selection encompasses a broad range of ideas some of which can be traced to the beginnings of armored-vehicle design. To provide for a high degree of potential applicability, much attention was given to concepts that could be reduced to practice by retrofit or field modification. The concepts that require intensive redesign or modification of the base vehicle are included more to stimulate total system thinking than to presume capability for the design of armored vehicles.

An arbitrary scale of effectiveness (E) has been applied to each concept using numbers from 1 to 10: for a low estimated effectiveness, E=1; and for a high estimated effectiveness, E=10. Intermediate numbers have a more or less linear relationship. These estimates were derived from judgments of the probable outcome of a vehicle when encountering either contact, delay, influence, or command mines. Then, in order to arrive at a simple, credible basis for comparison and selection, the numerical values assigned to each of the three measures of effectiveness were combined by addition. The numbers have not been weighted or otherwise manipulated.

For an example of the rationale used, Fig. 9 presents a comparison of baseline vehicle configurations using the M-48 tank, the M-113 armored personnel carrier, and the M-551 Sheridan reconnaissance vehicle. Each of these vehicles is judged to have a high mobility before hit, E=10; and zero mobility after hit, E=0. Their overall countermine effectiveness is then rated as $10 + 10 + 10 + 10 = 40$.

BASELINE DESCRIPTION	M-48 TANK					M-113 ARMORED PERSONNEL CARRIER					M-551 SHERIDAN RECON. VEHICLE				
	CON.	DEL.	INF.	COM.		CON.	DEL.	INF.	COM.		CON.	DEL.	INF.	COM.	
MINE TYPE EFFECTIVENESS: MOBILITY BEFORE HIT MOBILITY AFTER HIT RESISTANCE TO MOBILITY KILL															
	10	10	10	10		10	10	10	10		10	10	10	10	
	0	0	0	0		0	0	0	0		0	0	0	0	
	0	0	0	0		0	0	0	0		0	0	0	0	

Fig. 9. Effectiveness of baseline vehicles M-48, M-113, and M-551.

In Fig. 10, three outboard, ground-contacting, countermine vehicle accessory concepts are presented and rated by estimated effectiveness against hits from the same four mine types.

1. **Concept 1 — Plow.** When mobility before hit is evaluated, the plow is assumed to be deployed in a mine-clearing mode. This deployment severely limits cross-country speed of the vehicle, and the concept carries a heavy "Before Hit" mobility penalty. When the deployed plow encounters a mine, the mine is removed from the vehicle path unless anti-handling fuzing is used. Then, depending upon whether the encounter is destructive or nondestructive, the plow may be discarded, raised, or held in the mine-clearing position. Mobility is maintained. Since the plow effectiveness is generally insensitive to mine type, the concept is regarded as having a high resistance to mobility kill. One plow concept is shown in Fig. 11.

2. **Concept 2 — Roller #1.** This concept embodies a single-axis roller which clears mines by duplicating the ground-pressure signature of the vehicle that it precedes. The roller will also have an inherent magnetic and seismic signature that might be deliberately enhanced to provide a capability against influence-fuzed mines. The roller must "track" with the vehicle it is protecting, and this may tend to limit vehicle mobility somewhat. However, roller mobility appears higher than plow mobility in most situations. After a single mine hit, the vehicle will discard the roller and continue the mission with mobility unimpaired. A sample expendable roller concept is shown in Fig. 12.

3. **Concept 3 — Roller #2.** This concept is similar to the concept of the single-axis roller just described except that two banks of rollers are employed as a tandem unit. With its greater mass and size, this roller has a higher effectiveness than a single roller against influence mines, and its effectiveness against delay and command mines should be slightly better. The greater mass and size also work a penalty upon vehicle mobility before a mine hit.

Figure 13 presents two additional outboard, ground-contacting accessory concepts. These units are independently driven and thus differ significantly from the vehicle-powered accessories just described.

4. **Concept 4 — Forward-Wheel Signature Duplicator.** This is a tracked, independently powered outboard accessory. It clears mines from the path of the vehicle it precedes by duplicating the pressure, seismic, magnetic, or impulse signature of the combat vehicle. Several operational options are attractive with this concept. For example, in mobility operations, this accessory could be rigidly fixed to the basic vehicle and constrained to track with it (Fig. 14). The accessory vehicle would then serve to improve vehicle mobility. Delay or command mines would be expected to hit either

the accessory or the vehicle, but vehicle mobility would, in each case, be maintained. Additionally, the outboard accessory could be made to operate in a unique mine-clearing mode independent of the prime or basic mobility vehicle (Figs. 15, 16, 17). (The use of multiple, remote-mode, accessory units in wedge, line, column, or echelon formation is attractive but beyond the scope of this study.)

5. Concept 5 – Roller #3. This concept is similar to Concept 3 except that independent power is added to provide higher mobility before a mine hit. In summary, each of these outboard, ground-contacting accessory concepts will maintain much of the original vehicle mobility after a single mine encounter. However, severe penalties are incurred in mobility before the mine encounter in concepts 1 and 2.

6. Other Concepts. The remaining concepts are directed to envisioning the ways in which vehicle-drive redundancy may be achieved. Three variations of two tracks with only one track driven (on each side) are presented in Fig. 18. The black disc represents the vehicle drive sprocket. With the exception of the M-551, these concepts represent major modifications to equipment in the current inventory. A simple, shop-modification split track to the M-551 Sheridan is shown in Fig. 19. In each of these variations, mobility before a hit is greater than with unpowered, outboard accessories. Mobility then decreases with the number of ground-contacting, track-driven road wheels. To evaluate mobility after a hit implies that some degree of mobility remains. For this, the rear track and drive must be operable and the vehicle balance must not be seriously disturbed. For the evaluation of resistance to a mobility kill, BDARP data was used. It is important to note that resistance to a mobility kill decreases with reduced vulnerable target area.

Figure 20 depicts three variations of two driven tracks on each side of the vehicle. These concepts are definitely not in the “quick fix” category and would most likely require new vehicle design. The additional drive mechanism in these concepts increases mobility before hit to well above the three single-drive concepts just discussed. However, in either single drive or dual drive with double track, mobility after a hit is the same, but the double-drive, split track is much superior in terms of resistance to a mobility kill. (Again, the vulnerable target area has been reduced.)

Figure 21 depicts three variations of the Christie concept of independently driven road wheels. Mobility before a hit has been rated as equal to the mobility of the split-track, single-drive concepts. With two driven wheels, mobility after a hit is rated as quite low. An attractive feature of the Christie concept is the high resistance to a mobility kill when more than two road wheels are independently driven. Here, destruction of all mobility by a single mine is quite remote.




BASELINE DESCRIPTION	1. PLOW, TRACK WIDTH 					2. ROLLER, TRACK WIDTH, SINGLE WHEEL 					3. ROLLER, TRACK WIDTH, TWO WHEELS (TRACKED) 				
	CON.	DEL.	INF.	COM.		CON.	DEL.	INF.	COM.		CON.	DEL.	INF.	COM.	
EFFECTIVENESS: MOBILITY BEFORE HIT MOBILITY AFTER HIT RESISTANCE TO MOBILITY KILL															
	1	1	1	1		3	3	3	3		2	2	2	2	
	10	10	10	10		10	10	10	10		10	10	10	10	
	10	10	10	10		10	1	2	1		10	2	4	2	

Fig. 10. Effectiveness of outboard, ground-contacting countermine accessories.

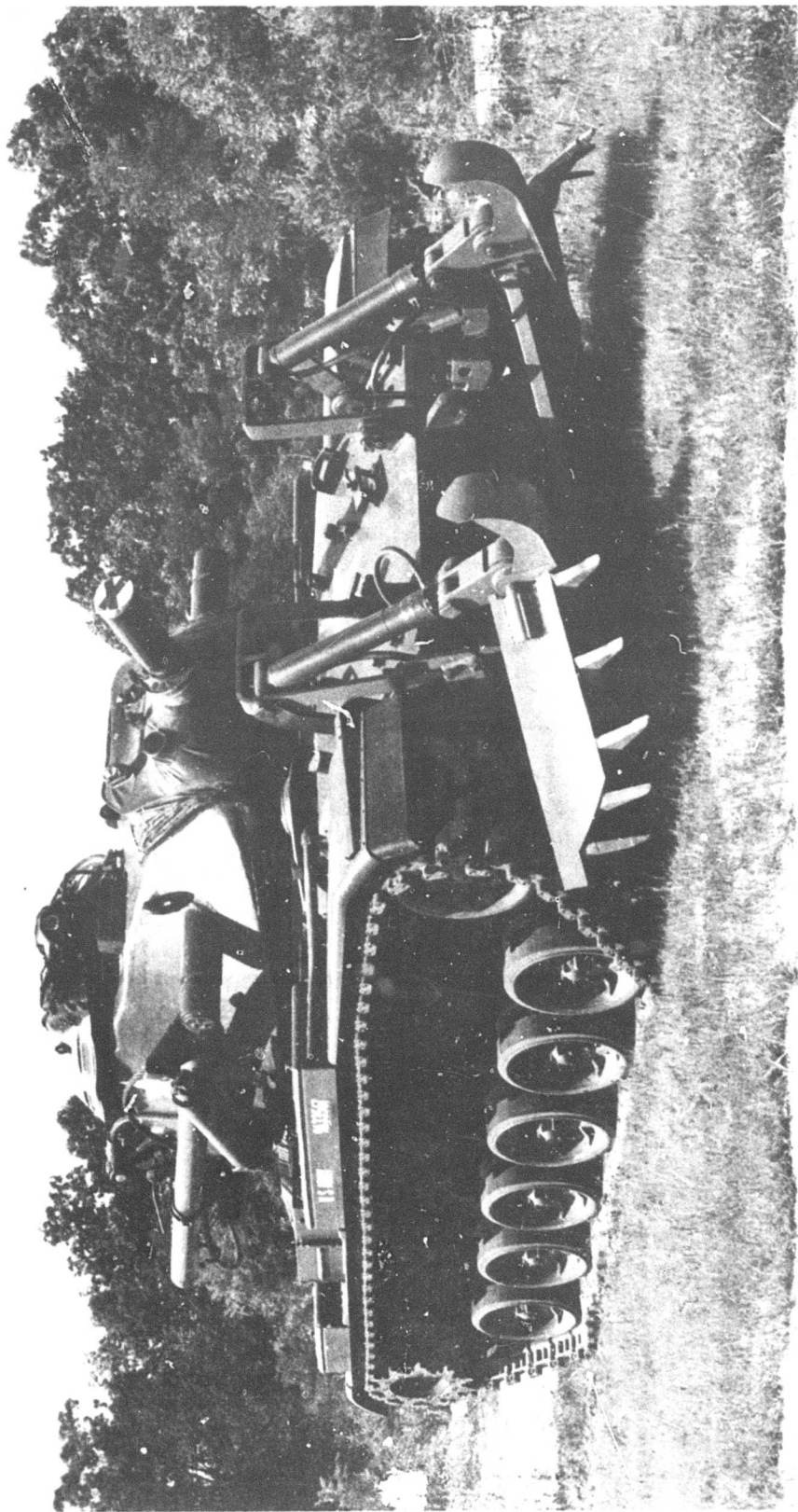
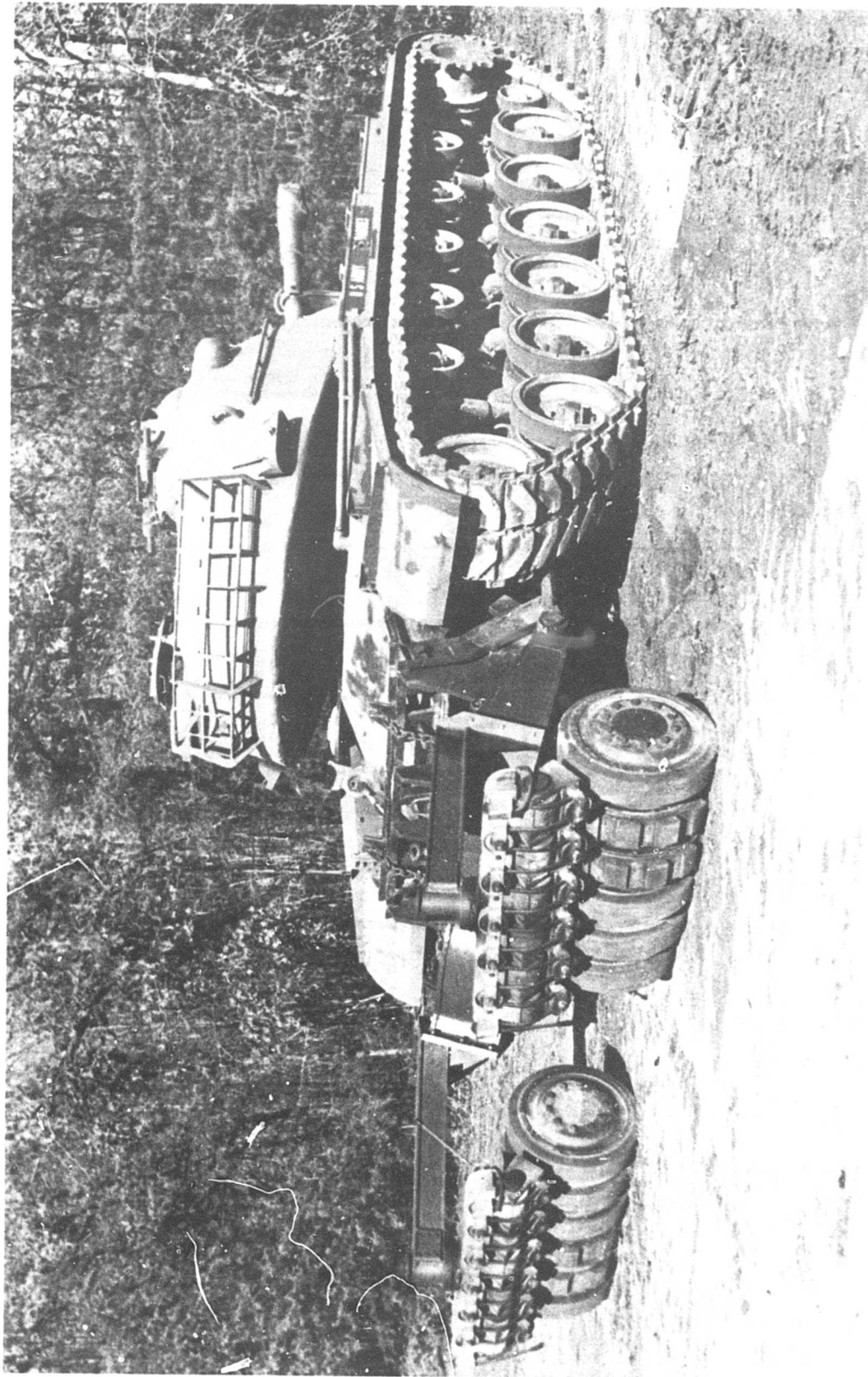


Fig. 11. Mine-clearing plow.

T12515



S1499

Fig. 12. Mine-clearing roller.



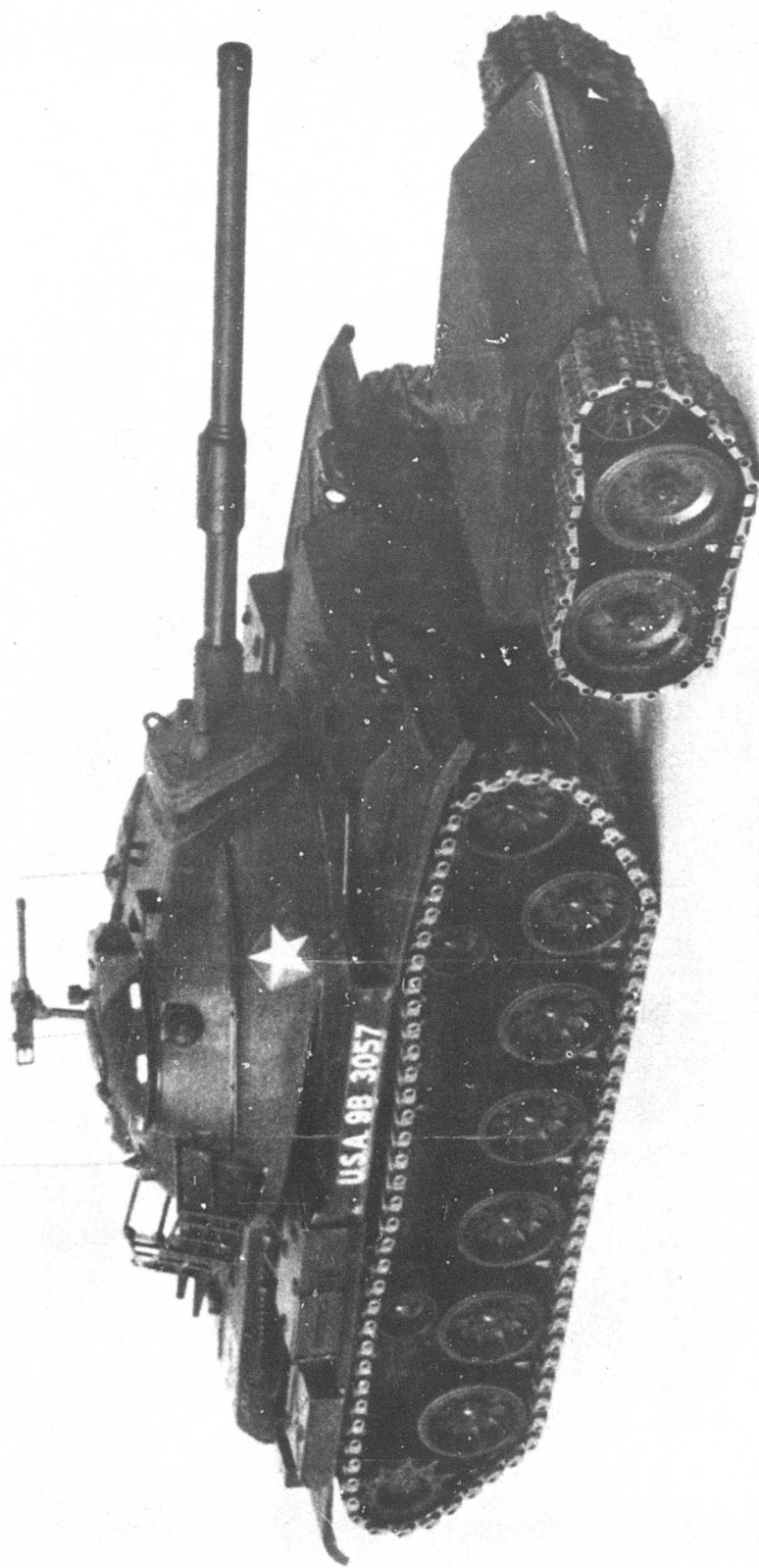
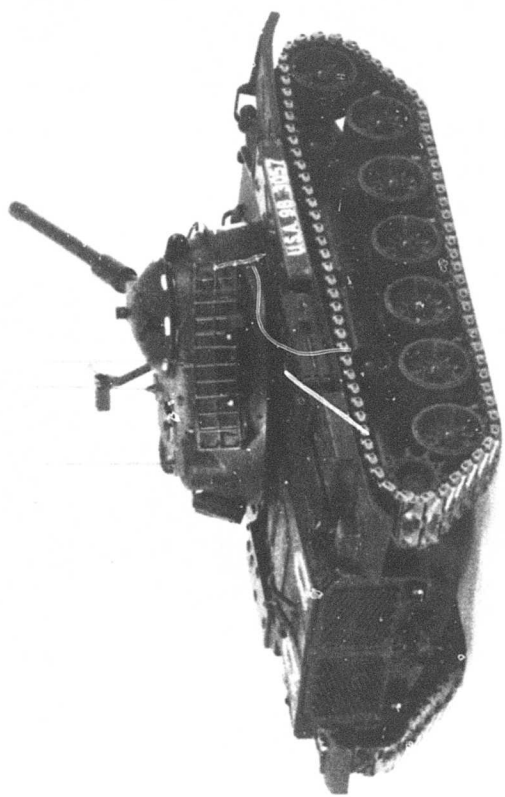
BASELINE DESCRIPTION	4. COMBAT TRACKED VEHICLE FRONT END SIGNATURE DUPLICATOR. 				5. ROLLER, TRACK WIDTH, POWERED. 							
	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.
EFFECTIVENESS: MOBILITY BEFORE HIT MOBILITY AFTER HIT RESISTANCE TO MOBILITY KILL												
	10	10	10	10	8	8	8	8				
	10	10	10	10	10	10	10	10				
	10	2	10	4	10	1	2	1				

Fig. 13. Effectiveness of outboard, ground-contacting countermine accessories—independently driven.



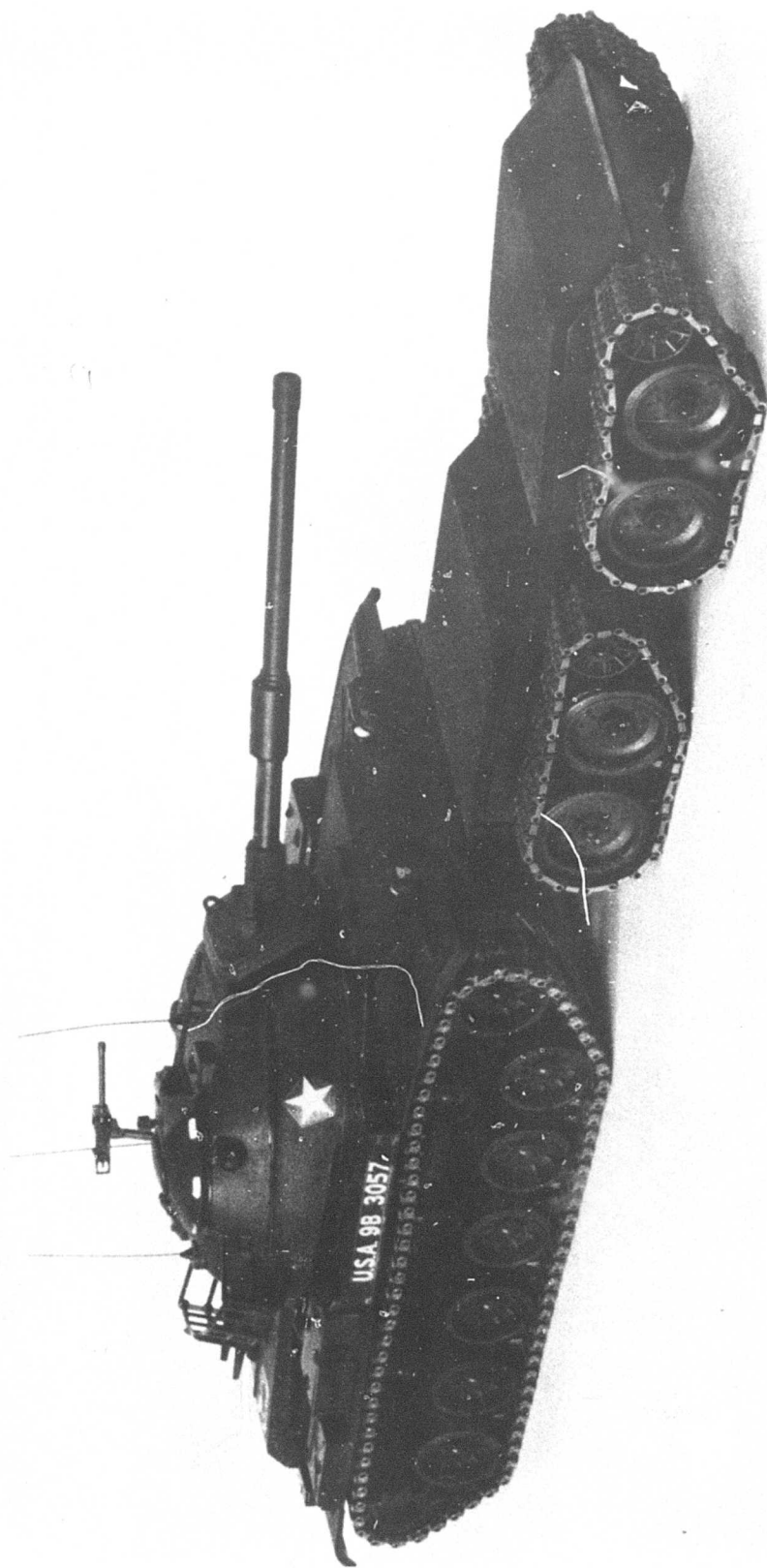
T12149

Fig. 14. Forward-wheel signature duplicator—independently driven, in close-coupled mode.



T12145

Fig. 15. Forward-wheel signature duplicator—independently driven, in remote mode.



T12152

Fig. 16. Forward-wheel signature duplicator—independently driven, in high-density threat mode.

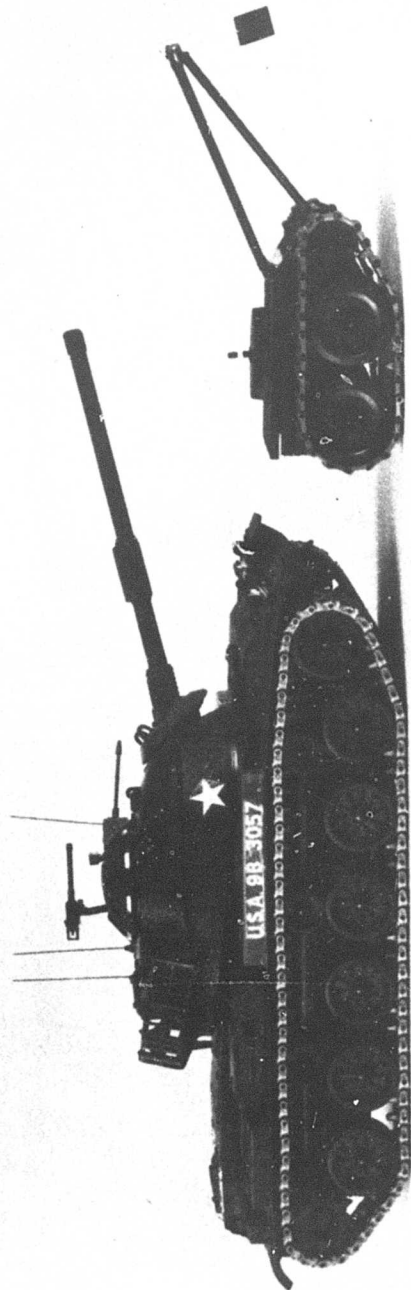


Fig. 17. Forward-wheel signature duplicator—independently driven, as a platform for detection and neutralization equipment.

T9562

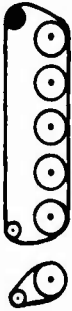


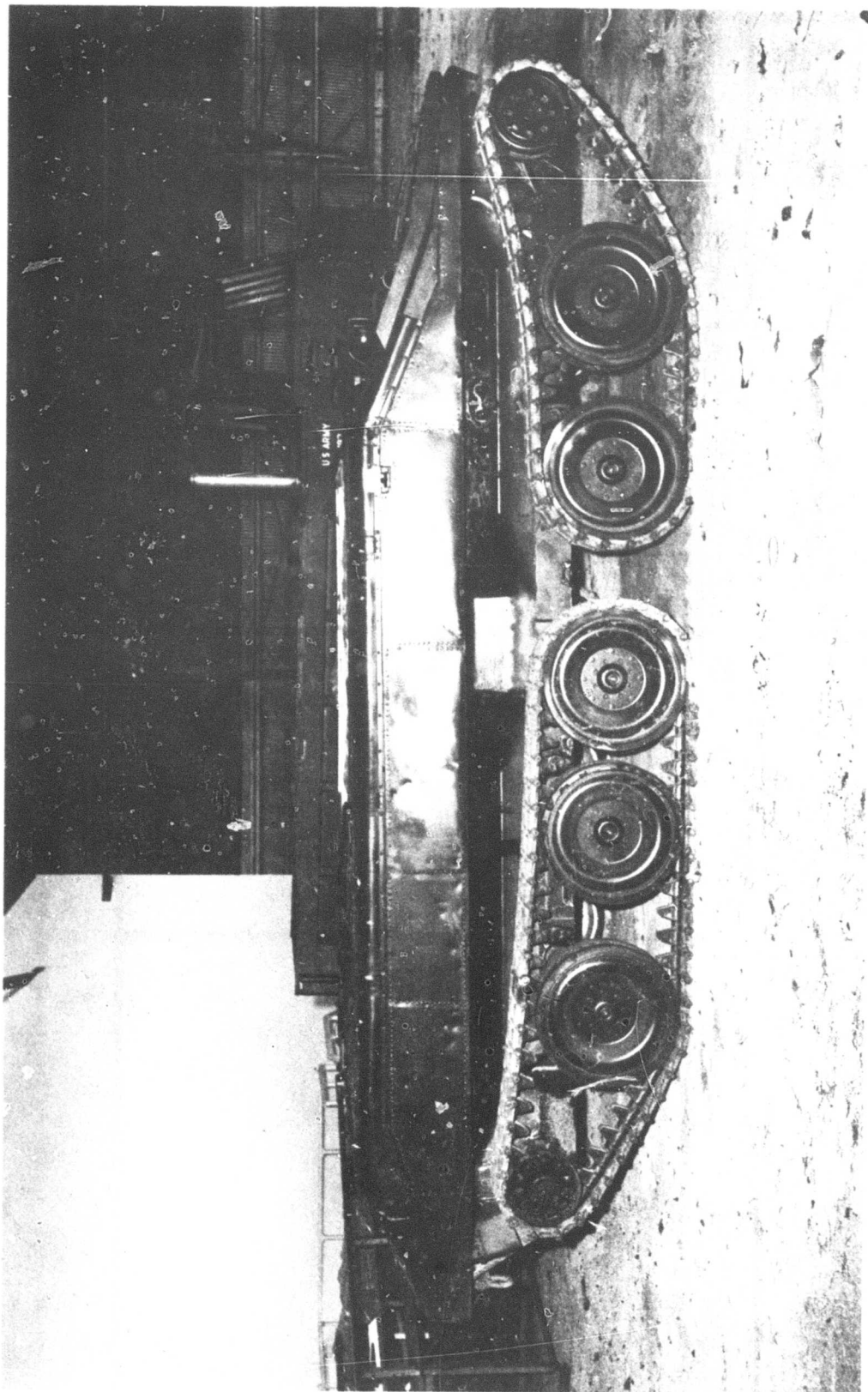
BASELINE DESCRIPTION	6. 1 WHEEL FORWARD					7. 2 WHEELS FORWARD					8. 3 WHEELS FORWARD				
															
MINE TYPE	CON.	DEL.	INF.	COM.		CON.	DEL.	INF.	COM.		CON.	DEL.	INF.	COM.	
EFFECTIVENESS: MOBILITY BEFORE HIT MOBILITY AFTER HIT RESISTANCE TO MOBILITY KILL															
	7	7	7	7		6	6	6	6		5	5	5	5	
	7	7	7	7		6	6	6	6		5	5	5	5	
	2	2	2	2		7	3	3	3		9	4	4	4	

Fig. 18. Effectiveness of single-drive, two-track mobility redundancy.



T9545
Fig. 19. Single-drive, two-track shop modification of Sheridan tank hull for mobility evaluation.

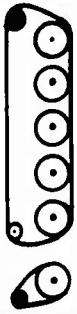


BASELINE DESCRIPTION	9. 1 WHEEL FORWARD					10. 2 WHEELS FORWARD					11. 3 WHEELS FORWARD				
															
MINE TYPE	CON.	DEL.	INF.	COM.		CON.	DEL.	INF.	COM.		CON.	DEL.	INF.	COM.	
EFFECTIVENESS: MOBILITY BEFORE HIT MOBILITY AFTER HIT RESISTANCE TO MOBILITY KILL															
	7	7	7	7		8	8	8	8		9	9	9	9	
	7	7	7	7		6	6	6	6		5	5	5	5	
	3	5	5	5		8	6	6	6		10	7	7	7	

Fig. 20. Effectiveness of two-drive, two-track mobility redundancy.

BASELINE DESCRIPTION	12. 2 WHEELS DRIVEN					13. 3 WHEELS DRIVEN					14. 4 WHEELS DRIVEN				
	● ○ ○ ○ ○ ●					● ○ ● ○ ○ ●					● ○ ● ● ● ●				
MINE TYPE	CON.	DEL.	INF.	COM.		CON.	DEL.	INF.	COM.		CON.	DEL.	INF.	COM.	
EFFECTIVENESS: MOBILITY BEFORE HIT MOBILITY AFTER HIT RESISTANCE TO MOBILITY KILL															
	5	5	5	5		6	6	6	6		7	7	7	7	
	2	2	2	2		5	5	5	5		8	8	8	8	
	9	6	6	6		10	8	8	8		10	10	10	10	

Fig. 21. Effectiveness of Christie-drive mobility redundancy.




BASELINE DESCRIPTION	15. 2 WHEELS DRIVEN				16. 3 WHEELS DRIVEN				17. 4 WHEELS DRIVEN			
												
MINE TYPE	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.
EFFECTIVENESS: MOBILITY BEFORE HIT MOBILITY AFTER HIT RESISTANCE TO MOBILITY KILL												
	10	10	10	10	10	10	10	10	10	10	10	10
	2	2	2	2	5	5	5	5	8	8	8	8
	9	6	6	6	10	8	8	8	10	10	10	10

Fig. 22. Effectiveness of independently driven, tracked wheels for mobility redundancy.

TRADE STUDY SUMMARY

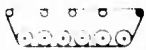
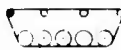






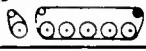

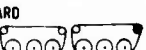
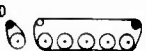
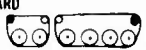
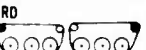






CONCEPT DESCRIPTION	EFFECTIVENESS	RELATIVE RANK
A M-48 TANK 	40	15/16
B M-113 APC 	40	15/16
C M-551 RECON VEHICLE 	40	15/16
1 PLOW TRACK WIDTH 	84	7
2 ROLLER TRACK WIDTH SINGLE WHEEL 	66	12
3 ROLLER TRACK WIDTH TWO WHEELS TRACKED 	66	12
4 COMBAT TRACKED VEHICLE FRONT END SIGNATURE DUPLICATOR 	106	2
5 ROLLER TRACK WIDTH POWERED 	86	6
6 1 WHEEL FORWARD 	64	13
7 2 WHEELS FORWARD 	64	13
8 3 WHEELS FORWARD 	61	14
9 1 WHEEL FORWARD 	74	11
10 2 WHEELS FORWARD 	82	8
11 3 WHEELS FORWARD 	87	5
12 2 WHEELS DRIVEN 	53	17/15
13 3 WHEELS DRIVEN 	78	9
14 4 WHEELS DRIVEN 	96	3
15 2 WHEELS DRIVEN 	75	10
16 3 WHEELS DRIVEN 	94	4
17 4 WHEELS DRIVEN 	112	1

Fig. 23. Comparison of relative effectiveness of concepts.

Figure 22 depicts three variations of tracked, independently driven road wheels. The only difference in effectiveness between these and the Christie concepts of Fig. 21 is higher mobility before a hit. This is due to the use of a track.

From this treatment of effectiveness against a specific threat, the 17 alternative concepts for a countermine mobility system may be compared and evaluated. The comparison is presented in Fig. 23. Three current vehicles, the M-48, M-113, and M-551, are included to serve as a baseline. At this point, it should again be emphasized that the assignment of numbers to the postulated measures of effectiveness is by no means absolute. These numbers are based upon engineering judgment made at this point in the study and will be revised and refined as the data base is strengthened. It does appear, however, that the conclusions to be derived from this treatment are relatively insensitive to the specific numerical values of effectiveness that have been assigned to the various conceptual approaches.

VIII. CONCLUSIONS

The following tentative conclusions appear to be credible and intuitively acceptable:

1. Outboard, independently driven, ground-contacting, signature-duplicating countermine accessories are:
 - a. Significantly more effective than similar unpowered units.
 - b. More effective than redundant tracks and drives.
 - c. As effective as three or more independently driven road wheels.
2. The use of such countermine outboard accessories can significantly improve and expand the mobility of the current family of armored, tracked, combat vehicles in a broad variety of missions where minefields or harassment mines may be encountered.
3. Although costs have not been formally considered in this study, it appears that the life-cycle costs of outboard countermine accessories would be quite low in comparison to vehicles incorporating redundancy of mine-susceptible drive components.

IX. PROPOSED FUTURE PLANS

The ACMES concept should be further examined and evaluated by means of the following tasks:

1. Design and build an experimental test model of a self-powered, tracked accessory that will duplicate the mine signature of a selected combat, armored, tracked vehicle.
2. Conduct an analysis/engineering study to further quantify and refine measures of effectiveness appropriate to both harassment mines and minefields.
3. Determine the relative cost of the most appropriate concepts presented in the present study.
4. Identify and evaluate power plants suitable for the ACMES concept as it may evolve.
5. Expand the current analysis to include multiple hits.
6. Prepare "design to" system engineering documentation for an independently driven, tracked, track-width, mine-clearing roller.
7. Initiate formal staffing of the first draft proposed materiel need (IDPMN) contained in Appendix B.

APPENDIX A

BATTLE DAMAGE ASSESSMENT AND
REPORTING TEAM (BDART) REPORTS

Completion Date 26 SEP 69

1. Case No. ABD 02 6908200
- ~~2. Number of incidents:~~ _____
3. Total Exhibits: 10
 - a. Photos 9
 - b. Fragments/Missiles 0
 - c. X-Rays 0
 - d. Other Exhibits 1
4. Incident Recapitulation:
 - a. Materiel 1
 - b. Personnel 0
5. Remarks:

*Only one personnel available for
interview*

EQUIP M113

Weapon: 60-LB mine

CASE NO. ABD 02 69082 00

DATE 26 Sep 69

INCIDENT COVER SHEET

Table of Contents

Quantity

Section A

- Part I - Case Scenario
- Part II - Equipment Damage
- Part III - Personnel Injuries
- Part IV - General
- Part V - Observer Interview
- Part VI - Sketch

1
1
1
1
1
0

Section B

- Set II - Wounding Agent Data
- Set IV - Autopsy Supplement
- Set V - Medical Evaluation and Treatment
- Set VI - Interview of Casualty
- Set VII - Interview of Others
- Set VIII - Burn Supplement
- Set IX - Body Armor
- Set XI - Troop Interview

1
1
1
1
1
1
1
1

Section C

- 1. Photographs (or negatives)
- 2. X-Rays
- 3. Recovered Missiles
- 4. Photo Caption Sheet
- 5. Other Exhibits *vehicle diagram*

9
0
0
1
1

FILM CAPTION DATA

CASE NO. ABD 02-69062-00

ROLL/PAK NO: 11	FILM TYPE Ektachrome	DATE 10 Sep 69
Location of Photo Coverage Quon Loi		
Photographer SSG Jones	Camera Number 4000	Lens Number Zoom
Frame No.	CAPTION	
1	Slate	
2	Left side	
3	Final drive assembly	
4	#1 roadwheel and hull damage	
5	#2 roadwheel	
6	Engine access area (door blown off)	
7	"	
8	Driver's seat --edge broken off by blast	
9	"	
NOT REPRODUCIBLE		

BATTLE DAMAGE ASSESSMENT AND RECOVERY TEAM

I-11

PART I - Case Scenario

SOURCES OF INFORMATION

Miller Paul F E-5
(Job Title or Position of Person Interviewed)

CASE # ASD-02-69082-00

479 - 62 - 8369 T.C
(Job Title or Position of Person Interviewed)

TEAM MEMBER SFC GALE

DATE 10 SEPT 69

(Job Title or Position of Person Interviewed)

SITREP

MSG

AFTER ACTION REPORT

(Other source of information)

(Other source of information)

1. Service involved: Army Navy Marines Air Force

2. Type Equipment:

<u>✓</u> M113 APC	<u>1</u> T Trk	<u>105</u> Howitzer	<u>Aircraft</u> (specify)
<u>M551</u>	<u>3/4</u> T Trk	<u>155</u> Howitzer	
<u>M48</u> Tank	<u>2 1/2</u> T Trk	<u>8"</u> Howitzer	
<u>M98</u> VTR	<u>Other</u>	<u>175mm</u> Gun	
<u>M106</u> Mortar Carrier		<u>4Cmn</u> "Duster"	
<u>M577</u> CP		<u>Towed</u>	
<u>M548</u> Cargo		<u>SP</u>	
<u>Other</u>		<u>Other</u>	

3. Federal Stock Number

4. USA Serial, Hull, or Tail Number 12A 69668

5. Unit Identification: a. 1-22 3/11 ACZ

b. APC 96257 c. CTZ I II (III) IV

6. Date/Time Group: a. Start of Mission 080800 SEPT 69

b. End of Mission

c. Of Incident 081100 SEPT 69

NOT REPRODUCIBLE

CASE # AF7- 02-69082-00

7. Location of Incident: a. UTM Coordinates XT 711 828
b. Geographical Name AN LOC
c. Map Sheet Number 6332 III
8. Name of operation or mission number UNK
- Brief description of maneuver during engagement, if possible, and remarks (sketch map oriented to north, time oriented, and direction of movement). Use Set 6 or reverse side of this page.
9. Equipment mileage or hour reading: a. Odometer or hour reading 2894
b. Mission mileage or time estimate UNK
10. Has this incident been reported by other means Yes ☒ No ☐ Unknown ☐
11. If so, describe or identify report(s) N/A
12. Size of friendly force: a. Squad b. Platoon c. Company
d. Battalion e. Brigade f. Other (specify)
1 TEP M-113 AND 1 COMPANY OF TANKS
13. Size of enemy force: a. 0-14 b. 15-60 c. 61-250 d. 251-700
UNK e. 700-1500 f. 1501-3500 g. Over 3500
14. Type of enemy force: VC NVA Other UNK
15. Estimated range in meters between forces at start of engagement:
a. 0-25 b. 26-50 c. 50-100 d. 100-150 e. 150-200
f. 200-300 g. Over 300 (specify) NINE DAMAGE ONLY
16. Type mission: a. Search & Destroy b. Recon c. Photo
d. Clearing e. Ambush f. Securing g. Combat Patrol
h. Inactive i. ☒ Recon in force j. Other (specify)
17. Deployment: a. Road March b. Covering c. Base Camp Defense
d. Landing e. Other (specify) COLUMN

CASE # ASD- 02-69082-00

18. Terrain Contour: a. Mountainous b. Hilly c. Gently Rolling
b. ☒ Level e. Other (specify) _____
19. Vegetation type: a. Jungle b. Clear Forest c. Brush d. High
Grass e. Tropical Swamp Forest f. ☒ Plantation
g. Cultivated Area h. Marsh i. Swamp
j. Paddy k. Other (specify) _____
20. Soil Type: 2. Sandy b. Silt c. ☒ Clay d. Gravel e. Other
(specify) _____
21. Soil Condition: ☒ Wet Dry
22. Equipment Speed: Was Equipment Moving when hit: ☒ Yes No
a. If moving, how fast 2-3 MPH
b. If speed was limited, why? (1) Terrain
(2) Other than Terrain
(3) ☒ Explain JUST START TO MOVE
23. Weather information:
a. Type: Rain Fog Clear Overcast Other (specify) _____
b. Temperature: 90 °F e. Wind velocity NONE
c. Wind direction SW d. Barometer reading _____
f. Relative humidity High
24. Visibility: a. Cloud cover ☒ Yes No b. Height 300 feet
c. Visible range 1000 METERS d. If night: Full Moon
Half Moon Quarter Moon Star-light Artificial
illumination (specify type) _____
25. Direction of attack: a. Frontal b. ☒ Left Flank c. Right Flank
d. Rear e. Other (specify) _____
26. Was enemy detected before he engaged? Yes ☒ No

NOT REPRODUCIBLE

02-69082-00

27. How soon after sighting enemy did you fire: a. Immediately b. ☒ Did not return fire e. Other (specify) _____
28. Who fired first: a. Friendly b. ☒ Enemy c. Unknown
29. Intensity of enemy fire: a. Light (1-10) b. Moderate (12-25)
c. Heavy (Over 25) d. Other (specify) MINE ONLY
30. Was cover and concealment used by friendly forces for personnel and/or equipment Yes ☒ No If yes, How? _____
31. What unused sources of cover and concealment were available: NONE
32. Acquisition information:
- a. How was enemy detected: Sight Hearing Sensor device (specify) _____
WAS NOT DETECTED
- b. What sensor (or sensor characteristics) would have detected the enemy earlier MINE DETECTOR
- c. How accurate was fix on enemy firing positions: 10 meters 25 Meters
50 Meters 100 Meters Over 100 Meters
- d. How was fix determined NO FIX MADE
- e. How long did it take you (or other crew members) to locate specific targets? NONE LOCATED
- f. If night, was night observation device used? Yes ☒ No
- g. If Yes, specify type? N/A
33. Aircraft: a. Altitude _____ b. Dive angle used _____
c. Airspeed _____ Knots d. Evasive action used _____
e. Type weapon _____ delivered _____
f. Time from takeoff to end of flight _____

02-68082-00

Escort aircraft ☐ Yes ☐ No If yes, list below:

<u>TYPE</u>	<u>NUMBER</u>	<u>MODEL</u>
-------------	---------------	--------------

Rotary Wing
Fixed Wing

h. Ground AA Fire information:

- (1) Was firing source observed? ☐ Yes ☐ No
- (2) Aircraft heading _____ degrees
- (3) Direction of source from aircraft (o'clock) _____
- (4) Source: Identified ☐ Yes ☐ No Attacked ☐ Yes ☐ No
- If identified, what (type weapons)? _____

PART II - EQUIPMENT DAMAGE

1. Equipment was Damaged Destroyed
2. Equipment was damaged or destroyed by:
- a. Direct fire e. AA Fire
- b. Indirect fire f. Accident (combat oriented)
- c. Mines g. Other (specify) _____
- d. Missiles *Belly armor was installed!*
3. What was mission of equipment? RECON IN FORCE
4. Number of hits for which collected data is described below 1

Hit Number	1	2	3	4
a. Weapon/Mine Type & Model	MINE			
b. Round size/mine weight	60			
c. Round type (AP, HE, etc).	HE			
d. Fuze type/identification: (airburst, ground-burst)	PRESSURE			
e. Estimates of where fuze functioned	ON CONTACT			
f. Range of weapon to target (in meters)	0			
g. Hit location (Station No., Frame #, General Description)	1ST RAD WHEEL			
h. Attack angle of projectile to equipment				
Azimuth	0			
Elevation	-90			

REF # 02-69082-00

1. Damaged major parts engine transmission transfer case
Suspension system Drive train Fire controls Main Armament
Communications equipment Radiator Wheels Other (specify)

Hit Number	1	2	3	4
j. Depth of Penetration (in inches)	N/A			
k. Did round perforate If Yes continue	Yes/No	Yes/No	Yes/No	Yes/No
l. Dimensions & shape of hole at entrance & exit	N/A			
m. Did spall occur	Yes/No	Yes/No	Yes/No	Yes/No
n. Effects of spall on personnel and components	N/A			
o. Path of penetrator/ perforation in equip- ment	N/A			
p. Projectile perfor- mance against spaced plates	N/A			

PIPE DAMAGE

5. Did a fire occur? Yes No

Cause of fire: Mine Direct fire weapon Indirect fire

Other (specify)

7. Location of fire damage

8. Damage caused by fire

NOT REPRODUCIBLE

FIRE DAMAGE (CONTINUED)

CASE # AFD- 02-69082-00

- Level of fuel (at time of incident): a. 1/2 b. 1/3 c. 3/4 d. Full
10. Material supporting combustion: a. Gasoline b. Diesel c. Ammo
11. Was fire suppression equipment available? Yes No
12. Was there time to operate fire suppression equipment? Yes No
13. Was the fire suppression equipment used? Yes No
14. What type of fire suppression equipment was used Installed Portable
Other (specify) _____
15. Was the fire suppression equipment effective? Yes No
16. Was there time to evacuate? Yes No
17. Did the crew evacuate? Driver Vch Comm Gunner Loader
Pilot Lt Seat Pilot Rt Seat
Yes No Yes No Yes No Yes No
- Others (crew members only) _____
Yes No Yes No Yes No Yes No

EXPLOSION DAMAGE (On or within the vehicle)

18. Did an internal explosion occur? Yes No
as a result of fire Yes No Unknown
- Was explosion Immediate Delayed. If delayed, how long _____
20. What was the cause of the explosion? Ammo Fuel Other (specify) _____
21. Damage caused by the explosion: _____

BLAST DAMAGE

22. Was equipment damaged by an external blast: Yes No
23. What was the distance from blast to equipment (in meters)? a. 0-10
b. 10-20 c. 20-30 d. Over 30 e. Other (specify) _____
24. Was equipment moved by the blast? Yes No If yes, how far? MOVED APPROX 1 METER
25. Was equipment overturned by the blast? Yes No
26. Was equipment damaged by fragments due to the blast? Yes No

BLAST DAMAGE (CONTINUED)

CASE # APD- 02-69082-00

27. Other damage caused by the blast? SEE BOTTOM OF PAGE

28. Describe fragment damage (if not covered elsewhere in form) _____

N/A

29. Were doors or hatches open on equipment when damaged? Yes No

Left Side:

FINAL DRIVE AND SPURGE BLOWN OFF

1ST ROAD WHEEL AND ROAD WHEELARCH BLOWN OFF

DENT IN SPONGON 1 METER LONG X 7 CM AT WIDEST POINT

HULL WARPED BETWEEN 1ST AND 2ND ROAD WHEEL

BOTH LATERALS DAMAGED

DRIVER SEAT BACK BLOWN OFF

BENT 50 CAL GUN SHIELD DOWN.

INTERNAL WIRING DAMAGED FOR RADIO

PART III - Personnel Injuries

1. Number of casualties (crew members only) None KIA 3 WIA DOW
MIA NEI IRHA

2. CASUALTY LEFT

	Driver Pilot Lt Seat	Veh Condr Pilot Rt Seat	Gunner	Loader	Other Specify
a. Hit Number	/	/	/		
b. Casualty was KIA, WIA, MIA, or DOW	WIA	WIA	WIA		
c. Location of wound (head, neck, hand, torso, etc.)	LEG.	ARM.	BACK		
d. To what extent did each wounded perform his mission	0	80	0		
e. Where was casualty's assigned station	DRIVER'S HATCH	TC CUPOLA	LEFT GUN		
f. Was casualty at his assigned station (YES or NO) If not, where was he	YES	YES	YES		
g. Was casualty evac- uated (YES or NO) If yes, by whom If yes, when	YES TO REAR AREA	YES TO REAR AREA	YES. TO REAR AREA		
h. Was casualty wearing protective clothing If yes, specify type of protective cloth- ing, i.e. body armor, flak jacket, etc.	NO	YES	YES		
i. Did protective cloth- ing prevent injury or reduce injury	N/A	YES	YES		
j. What caused casualty (1) Penetrator (2) Fragment (3) Blast (4) Shock (5) Other (specify other)	BLAST	BLAST	BLAST		

CASE # AED- 02-69082-00

3. Number of casualties (passengers only) None KIA VIA MLA
DOW NBI IRHA

PART IV

CASE # AED- 02-69082-00

1. Was equipment and/or major components operating when damaged? ☒ Yes ☐ No

Check equipment or components	Operating when damaged YES NO	Continued to operate YES NO	Remaining Capability (time related)	If shut down why?
Engine				
Transmission				
Transfer case				
Frame	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		SPROCKET blown off
Suspension	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		↓
Drive train	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Fire controls				
Main armament				
Communication equipment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Radiator				
Wheels	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		SPROCKET OFF
Other (specify)	SEE PAGE 9			

2. Was damaged equipment subsequently destroyed by friendly forces? ☐ Yes ☒ No

3. If equipment was damaged and had to be destroyed by friendly forces, was it used to aid in mission prior to destruction? ☐ Yes ☐ No N/A

4. If yes, how? N/A

5. Was damaged equipment repaired in field before mission was completed?
☐ Yes ☒ No If yes, estimate repair time (man hours) _____

6. Was equipment able to return to base or retreat to a safe location under its own power? ☐ Yes ☒ No If no, how retrieved TOWED BY VTR

NOT REPRODUCIBLE

CASE # AED- 02-69082-00

7. Was standard "On Vehicle Equipment" (OVE) in place on vehicle? ☒ Yes ☐ No
If no, where was it located? _____

8. What was composition and location of cargo? NONE

9. What additional items were on/or in the damaged equipment? NONE

10. Action of the equipment after receiving the hit:

Ground vehicle/equipment reaction to hit:

- a. ☐ Continued its activity in an operable state.
- b. ☐ Discontinued activity but remained in operable state
- c. ☒ Was rendered inoperable
- d. ☐ Scrapped

Aircraft Reaction to hit:

- e. ☐ Continued to fly; mission completed.
- f. ☐ Continued to fly; mission not completed
- g. ☐ Forced to land; inspection/quick fix/took off
- h. ☐ Forced to land; later destroyed
- i. ☐ Forced to land; later recovered
- j. ☐ Crashed; aircraft recovered
- k. ☐ Crashed; aircraft not recovered

11. Is equipment repairable: ☐ Yes ☒ No If repairable, at what echelon?

- a. ☐ Organizational b. ☐ DS Unit c. ☐ GS Unit d. ☐ Depot e. ☐ CGUS
- f. ☐ Other (specify) N/A

12. Estimate total down time for repairs (man hours) N/A

PART V

CASE # ABT- 02-67052-00

NAME/PAK MILLER PAUL F. E-5

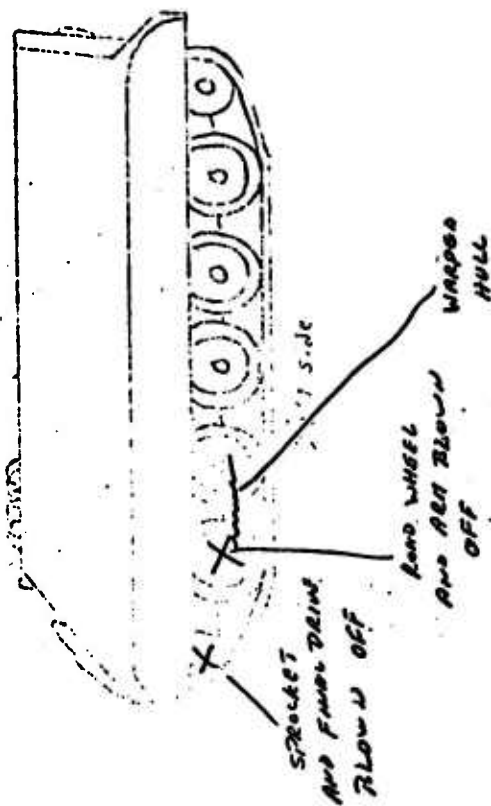
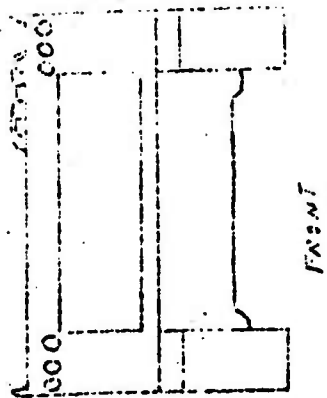
UNIT ITRP 3/11 ACR.

SSAN
UNIT 479-62-8369

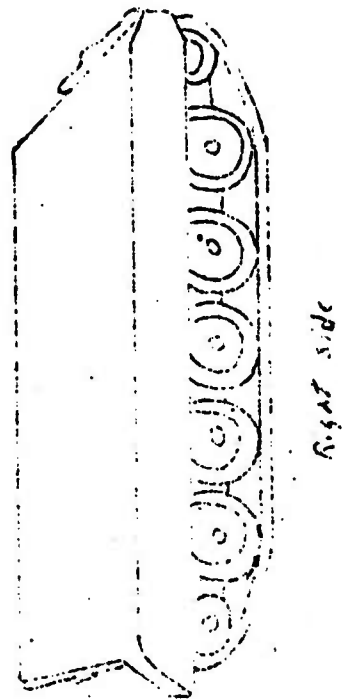
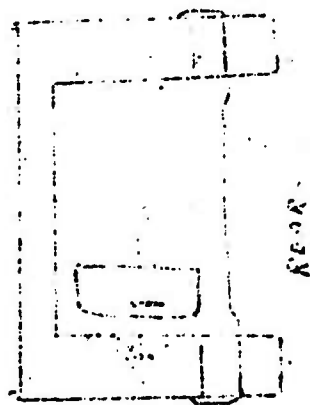
1. Responsibility of person interviewed TC-M-113 (I II)
2. Location of person interviewed at time of impact (relative to equipment damaged) TC-CUPOLA
3. Activity of person interviewed at time of impact GIVING DRIVER INSTRUCTIONS
4. Was the person interviewed wounded or injured as result of impact YES
5. Activity of the equipment at the time it was hit JUST STARTING TO MOVE
6. What type of protection is inherent at point of damage MINE KIT
7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred MINE KIT
8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred NO
9. Would any equipment modification reduce the degree of damage NO
10. Approximate distance from: a. Weapon to equipment 0 meters
b. Detonation of munition to equipment meter
11. What type of damage did the equipment receive? (Fire, explosion, missile, impregnation, etc.) BLAST
12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? Yes No Explain AVERAGE FOR MINE TYPE
13. Could damage have been prevented? Yes No How _____
14. Was the answer to above based on definite knowledge / possible knowledge _____, or no knowledge _____.
15. Does damage present a secondary hazard to personnel? Yes No If yes, explain _____

NOT REPRODUCIBLE

00-28069-20



NOT REPRODUCIBLE



HL

BDART(V)

(T)

Completion date: 30 Oct 69

1. Case Number: ABD-02-69/68-00
2. Total Exhibits: 16
 - a. Photographs: 16
 - b. Fragments/Missiles: 0
 - c. X-Rays: 0
 - d. Other Exhibits: 0
3. Recapitulation:
 - a. Materiel: 1
 - b. Personnel: 0
4. Remarks:

Equipment: M551
Weapon: 50-LB Mine

CASE NO. ARD 02-69108-00

DATE 30 OCT 69

INCIDENT COVER SHEET

Table of Contents

Quantity

Section A

Part I	- Case Scenario	<u>1</u>
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Part III	- Personnel Injuries	<u>1</u>
Part IV	- General	<u>1</u>
Part V	- Observer Interview	<u>2</u>
Part VI	- Sketch	<u>1</u>

Section B

Set II	- Wounding Agent Data	<u>0</u>
Set IV	- Autopsy Supplement	<u>0</u>
Set V	- Medical Evaluation and Treatment	<u>0</u>
Set VI	- Interview of Casualty	<u>0</u>
Set VII	- Interview of Others	<u>0</u>
Set VIII	- Burn Supplement	<u>0</u>
Set IX	- Body Armor	<u>0</u>
Set XI	- Troop Interview	<u>0</u>

Section C

1.	Photographs (or negatives)	<u>16</u>
2.	X-Rays	<u>0</u>
3.	Recovered Missiles	<u>0</u>
4.	Photo Caption Sheet	<u>1</u>
5.	Other Exhibits	<u>VEHICLE DIAGRAM</u>

FILM CAPTION DATA

CASE NO. ABD 02-69108-03

ROLL/PAK NO: Roll-30	FILM TYPE High Speed Ektachrome	DATE 22 Oct 69
Location of Photo Coverage Quan Loi, Vietnam		
Photographer SFC Cantu	Camera Number 3269	Lens Number Zoom-in lens
Frame No.	CAPTION	
1.	Slate	
2.	Left rear view of vehicle	
3.	Left front view of vehicle	
4.	View of damage to vehicle	
5.	Damage to idler wheel and track adjuster on left side. Track adjuster broken from 1st road wheel on left side.	
6.	Damage to 1st road wheel on left side, road wheel blown off and road wheel arm warped	
7.	Close view of road wheel arm and part of road wheel	
8.	Damage to shock absorber on left side and 2nd road wheel arm warped and road wheel blown off. Bolts from road wheel arm mounting bracket were removed, no damage to mounting bracket.	
9.	Damage to shock absorber on left side	
10.	Front view of damage to shock absorber on left side	
11.	Damage to 2nd road wheel mounting on left side	
12.	Damage to suspension on front left side	
13.	Damage to suspension from front to rear on left side	
14.	Same as # 13	
15.	Same as # 13	
16.	Same as # 13	
(Measurement device graduated in cm.)		
NOT REPRODUCIBLE 53		

BATTLE DAMAGE ASSESSMENT AND REPORTING TEAM

PART I -- Case Scenario

SOURCES OF INFORMATION

FRANK R. BENTLEY DRIVER
(Job Title or Position of Person Interviewed)

CASE # ASD-02-67108-00

TEAM MEMBER SFC GIFT

(Job Title or Position of Person Interviewed)

DATE 22 OCT 69

(Job Title or Position of Person Interviewed)

SITREP

PMR

AFTER ACTION REPORT

(Other source of information)

(Other source of information)

1. Service involved: ☒ Army ☐ Navy ☐ Marines ☐ Air Force

2. Type Equipment:

<u>M113 APC</u>	<u>1/2 T Trk</u>	<u>105 Howitzer</u>	<u>Aircraft</u>
<u>M551</u>	<u>3/4 T Trk</u>	<u>155 Howitzer</u>	<u>(specify)</u>
<u>M48 Tank</u>	<u>2 1/2 T Trk</u>	<u>8" Howitzer</u>	
<u>M88 VTR</u>	<u>Other</u>	<u>175mm Gun</u>	
<u>M106 Mortar Carrier</u>		<u>40mm "Duster"</u>	
<u>M577 CP</u>		<u>Towed</u>	
<u>M548 Cargo</u>		<u>SP</u>	
<u>Other</u>		<u>Other</u>	

3. Federal Stock Number 2350-873-5408

4. USA Serial, Hull, or Tail Number USA 12067368 C-37

5. Unit Identification: a. C TRP 11th ACR

b. APO 96257 c. CTZ I II III IV

6. Date/Time Group: a. Start of Mission 21 0930 OCT 69

b. End of Mission UNK

c. Of Incident 21 1230 OCT 69

02-67108-00

7. Location of Incident: a. UTM Coordinates XU 854 857
b. Geographical Name AN Loc
c. Map Sheet Number 6332 III Series L 7014

8. Name of operation or mission number UNK

Brief description of maneuver during engagement, if possible, and remarks
(sketch map oriented to north, time oriented, and direction of movement).
Use Set 6 or reverse side of this page.

9. Equipment mileage or hour readings: a. Odometer or hour reading Spandometric Broken
b. Mission mileage or time estimate UNK
10. Has this incident been reported by other means Yes ☒ No ☐ Unknown
11. If so, describe or identify report(s) N/A
12. Size of friendly force: a. ☐ Squad b. ☐ Platoon c. ☒ Company
d. ☐ Battalion e. ☐ Brigade f. ☐ Other (specify)
13. Size of enemy force: a. ☐ 0-14 b. ☐ 15-60 c. ☐ 61-250 d. ☐ 251-700
MINE DAMAGE e. ☐ 700-1500 f. ☐ 1501-3500 g. ☐ Over 3500
14. Type of enemy force: ☐ VC ☐ NVA ☐ Other UNK
15. Estimated range in meters between forces at start of engagement:
a. ☐ 0-25 b. ☐ 25-50 c. ☐ 50-100 d. ☐ 100-150 e. ☐ 150-200
f. ☐ 200-300 g. ☐ Over 300 (specify) MINE DAMAGE
16. Type mission: a. ☐ Search & Destroy b. ☐ Recon c. ☐ Photo
d. ☐ Clearing e. ☐ Ambush f. ☐ Securing g. ☐ Combat Patrol
h. ☐ Inactive i. ☒ Recon in force j. ☐ Other (specify)
17. Deployment: a. ☐ Road March b. ☐ Covering c. ☐ Base Camp Defense
d. ☐ Landing e. ☒ Other (specify) ON-LINE RIFT

CASE # AMP-02-69108-20

18. Terrain Contour: a. Mountains b. Hilly c. Gently Rolling
d. Level e. Other (specify) _____
19. Vegetation type: a. Jungle b. Clear Forest c. Brush d. High
Grass e. Tropical Swamp Forest f. Plantation
g. Cultivated Area h. Marsh i. Swamp
j. Paddy k. Other (specify) _____
20. Soil Type: 2. Sandy b. Silt c. Clay d. Gravel e. Other
(specify) _____
21. Soil Condition: Wet Dry
22. Equipment Speed: Was Equipment Moving when hit: Yes No
a. If moving, how fast 3 MPH
b. If speed was limited, why? (1) Terrain
(2) Other than Terrain
(3) Explain NORMAL FOR RIET
23. Weather information:
a. Type: Rain Fog Clear Overcast Other (specify) _____
b. Temperature: 80-85 °F c. Wind velocity NONE
d. Wind direction NONE e. Barometer reading NK
f. Relative humidity High
24. Visibility: a. Cloud cover Yes No b. Height _____ feet
c. Visible range INDEFINITE d. If night: Full Moon
Half Moon Quarter Moon Star-light Artificial
illumination (specify type) _____
25. Direction of attack: a. Frontal b. Left Flank c. Right Flank
d. Rear e. Other (specify) MINE DAMAGE
26. Was enemy detected before he engaged? Yes No

ABD-02-69108-00

27. How soon after sighting enemy did you fire: a. Immediately b. Did not return fire c. Other (specify) N/A
28. Who fired first: a. Friendly b. Enemy c. Unknown MINE DAMAGE
29. Intensity of enemy fire: a. Light (1-10) b. Moderate (11-25) c. Heavy (Over 25) d. Comments N/A
30. Was cover and concealment used by friendly forces for personnel and/or equipment Yes No If yes, How? N/A
31. What unused sources of cover and concealment were available: N/A
32. Acquisition information:
- a. How was enemy detected: Sight Hearing Sensor device (specify)
NOT DETECTED
- b. What sensor (or sensor characteristics) would have detected the enemy earlier MINE SWEEP
- c. How accurate was fix on enemy firing positions: 10 meters 25 Meters 50 Meters 100 Meters Over 100 Meters N/A
- d. How was fix determined? WAS NOT
- e. How long did it take you (or other crew members) to locate specific targets? NONE LOCATED
- f. If night, was night observation device used? Yes No N/A
- g. If Yes, specify type? N/A
33. Aircraft: a. Altitude _____ b. Dive angle used _____
c. Airspeed _____ Knots d. Evasive action used _____
e. Type weapon or munition delivered _____
f. Time formation during flight _____

02-6948-22

g. Escort aircraft ☐ Yes ☐ No If yes, list below:

TYPE

NUMBER

MODEL

Rotary Wing

Fixed Wing

h. Ground AA Fire information: *N/A*

(1) Was firing source observed? ☐ Yes ☐ No

(2) Aircraft heading _____ degrees

(3) Direction of source from aircraft (o'clock) _____

(4) Source: Identified ☐ Yes ☐ No Attacked ☐ Yes ☐ No

If identified, what (type weapons)? _____

ABD 22-69/08-00

PART II - EQUIPMENT DAMAGE

1. Equipment was ☒ Damaged ☐ Destroyed ARMOR KIT INSTALLED
2. Equipment was 'damaged' or 'destroyed' by:
- a. ☐ Direct fire
 - b. ☐ Indirect fire
 - c. ☒ Mines
 - d. ☐ Missiles
 - e. ☐ AA Fire
 - f. ☐ Accident (combat oriented)
 - g. ☐ Other (specify) _____
3. What was mission of equipment? RIFT
4. Number of hits for which collected data is described below? 1

Hit Number	1	2	3	4
a. Weapon/Mine Type & Model	ANTI-TANK MINE			
b. Round size/mine weight	50-16			
c. Round type (AP, HE, etc).	HE			
d. Fuze type/identification: (airburst, ground-burst)	PRESSURE TYPE			
e. Estimates of where fuze functioned	ON CONTACT			
f. Range of weapon to target (in meters)	0			
g. Hit location (Station No., Frame #, General Description)	LEFT FRONT 1st Road-wheel			
h. Attack angle of projectile to equipment				
Azimuth	0°			
Elevation	-90			

FORM # 100-02-69108-00

1. Damaged major parts ☐ engine ☐ transmission ☐ transfer case
☒ Suspension system ☐ Drive train ☐ Fire controls ☒ Main Armament
☐ Communications equipment ☐ Radiator ☐ Wheels ☐ Other (specify)

Hit Number	1	2	3	4
j. Depth of Penetration (in inches)	N/A			
k. Did round perforate If Yes continue	Yes (C)	Yes/No	Yes/No	Yes/No
l. Dimensions & shape of hole at entrance & exit	N/A			
m. Did spall occur	Yes (C)	Yes/No	Yes/No	Yes/No
n. Effects of spall on personnel and components	N/A			
o. Path of penetrator/ perforation in equip- ment	N/A			
p. Projectile perfor- mance against spaced plates	N/A			

FIRE DAMAGE

5. Did a fire occur? ☐ Yes ☒ No
6. Cause of fire: ☐ Mine ☐ Direct fire weapon ☐ Indirect fire
☐ Other (explain) N/A
7. Location of fire damage N/A
8. Damage caused by fire N/A

FIRE DAMAGE (CONTINUED)

CASE # AND 02-69108-00

9. Level of fuel (at time of incident): a. $\frac{1}{2}$ b. $\frac{1}{4}$ c. $\frac{3}{4}$ d. Full *N/A*
10. Material supporting combustion: a. Gasoline b. Diesel c. Ammo *N/A*
11. Was fire suppression equipment available? ☐ Yes ☐ No *N/A*
12. Was there time to operate fire suppression equipment? ☐ Yes ☐ No *N/A*
13. Was the fire suppression equipment used? ☐ Yes ☐ No *N/A*
14. What type of fire suppression equipment was used ☐ Installed ☐ Portable
☐ Other (specify) *N/A*
15. Was the fire suppression equipment effective? ☐ Yes ☐ No *N/A*
16. Was there time to evacuate? ☐ Yes ☐ No *N/A*
17. Did the crew evacuate? Driver Vch Com'r Gunner Loader
Pilot Lt Seat Pilot Rt Seat
N/A ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No
Others (crew members only) _____
☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No

EXPLOSION DAMAGE (On or within the vehicle)

18. Did an internal explosion occur? ☐ Yes ☒ No
as a result of fire ☐ Yes ☐ No ☐ Unknown
19. Was explosion ☐ Immediate ☐ Delayed. If delayed, how long *N/A*
20. What was the cause of the explosion ☐ Ammo ☐ Fuel ☐ Other (specify)
N/A
21. Damage caused by the explosion: *N/A*

BLAST DAMAGE

22. Was equipment damaged by an external blast: ☒ Yes ☐ No
23. What was the distance from blast to equipment (in meters)? a. ☒ 0-10
b. ☐ 10-20 c. ☐ 20-30 d. ☐ Over 30 e. ☐ Other (specify) *
24. Was equipment moved by the blast? ☒ Yes ☐ No If yes, how far? *RAISED OFF GROUND Approx 12 inches*
25. Was equipment overturned by the blast? ☐ Yes ☒ No
26. Was equipment damaged by fragments due to the blast? ☐ Yes ☒ No

BLAST DAMAGE (CONTINUED)

CASE # ARD-02-69108-00

27. Other damage caused by the blast: Sponson bent, 1st & 2nd Roadwheels
BLOWN OFF, Idler ARM, #1 Shock ARM & ROAD wheel ARMS 1 & 2
28. Describe fragment damage (if not covered elsewhere in form) _____
N/A
29. Were doors or hatches open on equipment when damaged? ☒ Yes ☐ No

(27 CONT'D): Damaged. 11 Rounds of Ammunition
 Broken. ALL Broken where powder casing
 meets projectile. AMMO STORED IN RACKS IN
 DRIVER'S HATCH.
 ARMAMENT: MAIN GUN will NOT ELEVATE OR
 DEPRESS.

Idler Arm Separated from Idler wheel
 #1 Shock Separated from Roadwheel
 TRACK Adjusting ARM torn loose from #1 Roadwheel AREA.

NOT REPRODUCIBLE

ABD 02-62105-00

PART III - Personnel Injuries

1. Number of casualties (crew members only) ☒ One ☐ KIA ☐ MIA ☐ DOW
☐ MIA ☐ MBI ☐ IRMA

CASUALTY

2.

	Driver Pilot Lt Seat	Veh Cdr Pilot Rt Seat	Gunner	Loader	Other Specify
a. Hit Number					
b. Casualty was KIA, MIA, MIA, or DOW					
c. Location of wound (head, neck, hand, torso, etc.)					
d. To what extent did each wounded perform his mission					
e. Where was casualty's assigned station					
f. Was casualty at his assigned station (YES or NO) If not, where was he					
g. Was casualty evac- uated (YES or NO) If yes, by whom If yes, when					
h. Was casualty wearing protective clothing If yes, specify type of protective cloth- ing, i.e. body armor, flak jacket, etc.					
i. Did protective cloth- ing prevent injury or reduce injury					
j. What caused casualty (1) Penetrator (2) Fragment (3) Blast (4) Shock (5) Other (specify other)					

CASE # ABD-02-69/08-00

3. Number of casualties (passengers only) ☒ None ☐ KIA ☐ WIA ☐ MIA
☐ DOW ☐ NBI ☐ IRHA

CASE # ABT-02-6908-00

1. Was equipment and/or major components operating when damaged? ☒ Yes ☐ No

Check equipment or components	Operating when damaged		Continued to operate		Remaining Capability (time related)	If shut down why?
	YES	NO	YES	NO		
Engine						
Transmission						
Transfer case						
Frame						
<input checked="" type="checkbox"/> Suspension	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	NONE	TRACK blown OFF
Drive train						
Fire controls						
<input checked="" type="checkbox"/> Main armament	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	NONE	
Communication equipment						
Radiator						
<input checked="" type="checkbox"/> Wheels	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	NONE	
Other (specify)						

2. Was damaged equipment subsequently destroyed by friendly forces? ☐ Yes ☒ No

3. If equipment was damaged and had to be destroyed by friendly forces, was it used to aid in mission prior to destruction? ☐ Yes ☐ No N/A

4. If yes, how? N/A

5. Was damaged equipment repaired in field before mission was completed? ☐ Yes ☒ No If yes, estimate repair time (man hours) _____

6. Was equipment able to return to base or retreat to a safe location under its own power? ☐ Yes ☒ No If no, how retrieved ANOTHER M561

TOWED IT IN WITH TOW BAR

CASE # AND-02-69108-00

7. Was standard "On Vehicle Equipment" (OVE) in place on vehicle? ☒ Yes ☐ No
If no, where was it located? _____
8. What was composition and location of cargo? PERSONAL GEAR ON
CARGO RACK ON REAR OF TURRET
9. What additional items were on/or in the 'damaged' equipment? NONE
10. Action of the equipment after receiving the hit:
Ground vehicle/equipment reaction to hit:
a. ☐ Continued its activity in an operable state.
b. ☐ Discontinued activity but remained in operable state
c. ☒ Was rendered inoperable
d. ☐ Scrapped
Aircraft Reaction to hit:
e. ☐ Continued to fly; mission completed.
f. ☐ Continued to fly; mission not completed
g. ☐ Forced to land; inspection/quick fix/took off
h. ☐ Forced to land; later destroyed
i. ☐ Forced to land; later recovered
j. ☐ Crashed; aircraft recovered
k. ☐ Crashed; aircraft not recovered
11. Is equipment repairable: ☒ Yes ☐ No If repairable, at what echelon?
a. ☐ Organizational b. ☐ DS Unit c. ☒ GS Unit d. ☐ Depot e. ☐ CCMS
f. ☐ Other (specify) _____
12. Estimate total down time for repairs (man hours) UNK

CASE # ABD-02-69108-00

NAME/RANK SPIRES, JAMES E.

ES. # 265-86-9297

UNIT C TRP 4TH ACR

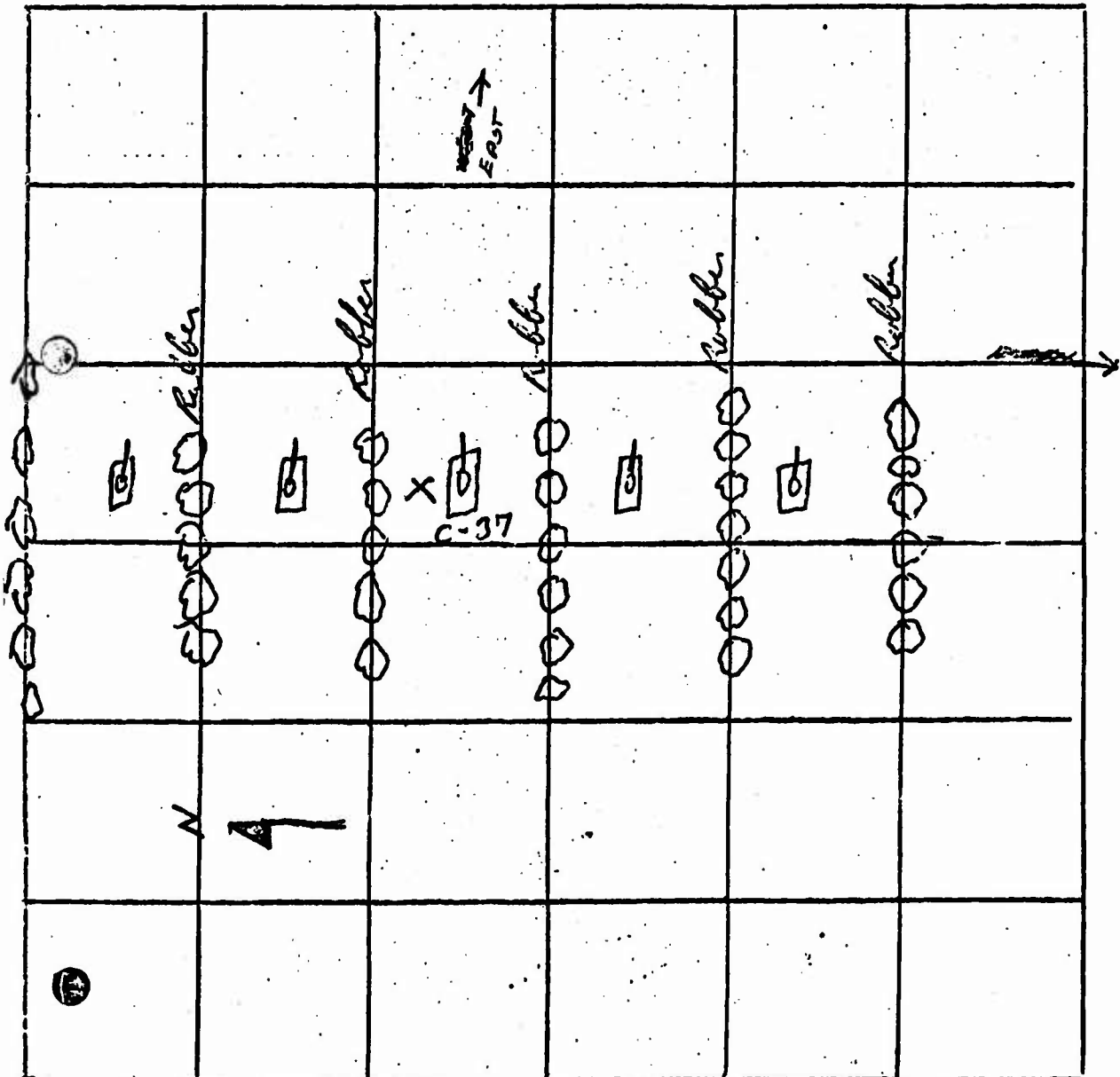
1. Responsibility of person interviewed DRIVER
2. Location of person interviewed at time of impact (relative to equipment damaged) DRIVER'S COMPARTMENT
3. Activity of person interviewed at time of impact DRIVING
4. Was the person interviewed wounded or injured as result of impact NO
5. Activity of the equipment at the time it was hit MOVING FORWARD
6. What type of protection is inherent at point of damage MINIE PLATE
UNDER SPANSON
7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred YES - MINIE PLATE
8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred NO
9. Would any equipment modification reduce the degree of damage EXTEND MINIE PLATE FURTHER FORWARD
10. Approximate distance from: a. Weapon to equipment _____ meters
b. Detonation of munition to equipment 0 meter
11. What type of damage did the equipment receive? (Fire, explosion, missile, impregnation, etc.) MINIE DAMAGE
12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? Yes ☒ No Explain LESS due to MINIE PLATE
13. Could damage have been prevented? Yes ☒ No How _____
14. Was the answer to above based on definite knowledge ☒, possible knowledge _____, or no knowledge _____.
15. Does damage present a secondary hazard to personnel? Yes ☒ No If yes, explain _____

PART VI

NAME/RANK SP5 *James E. Irwin*
 (Person drawing sketch)
 SSAN 265-86-9297
 COORDINATES X4854857

CASE NO. 02-69108-10
 TEAM MEMBER SFC. *GIFT*
 DATE 22 OCT 69

SKETCH



NAME/RANK PFC SCOTT PFC

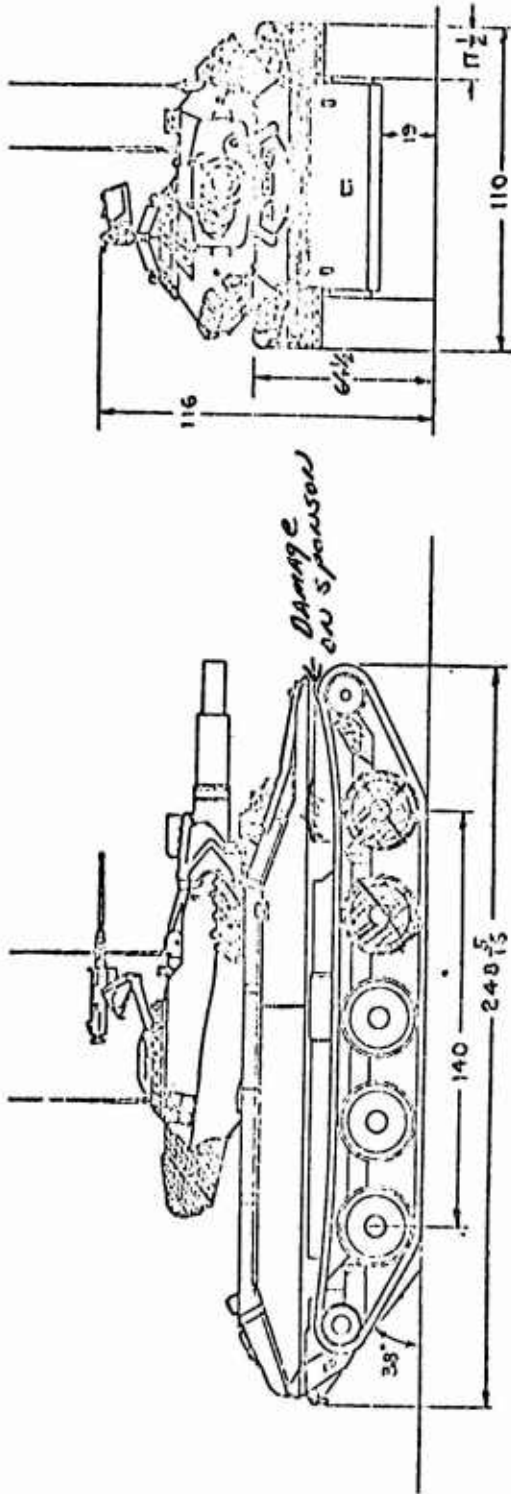
^{ADP}
CASE NO. 02-69108-00

IN 527-92-8558

PART V - Observer Interview Form

1. Responsibility of person interviewed Leader
2. Location of person interviewed at time of impact (relative to equipment damaged)
Leader's Hatch
3. Activity of person interviewed at time of impact Observing
4. Was the person interviewed wounded or injured as result of impact NO
5. Activity of the equipment at the time it was hit Reced in Force
6. What type of protection is inherent at point of damage body of Vehicle
ARMOR
7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred NO
8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred NO
9. Would any equipment modification reduce the degree of damage yes
Explain extended SPONSOR ARMOR ON THE WAY TO THE REAR
10. Approximate distance from: a. Weapon to equipment 0 meters
b. Detonation of munition to equipment 0 meters
11. What type of damage did the equipment receive? (Fire, explosion, missile impregnation, etc.) BLAST
12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? Yes No Explain FIRST MINE HIT
13. Could damage have been prevented? Yes ☒ No How
14. Was the answer to above based on definite knowledge ✓, possible knowledge , or no knowledge
15. Does damage present a secondary hazard to personnel? Yes ☒ No
If yes, explain

LEFT FRONT C-37



NOT REPRODUCIBLE

BDART(V)

(F)

Completion date: 21 Jan 70

70002-00

1. Case Number: ABD-02-~~44~~

2. Total Exhibits: 19

a. Photographs: 17

b. Fragments/Missiles: 0

c. X-Rays: 0

d. Other Exhibits: 2

3. Recapitulation:

a. Materiel: 1

b. Personnel: 0

4. Remarks:

EQUIPMENT - M48

WEAPON - 20-LB
MINE

CASE NUMBER: ABD-02-70002-00

DATE:

INCIDENT COVER SHEET

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Part II - Equipment Damage	<u>1</u>
Part III - Personnel Injuries	<u>1</u>
Part IV - General	<u>1</u>
Part V - Observer Interview	<u>2</u>
Part VI - Sketch (Optional)	<u>1</u>
<u>Section B</u>	
Set I - Body Diagrams	<u>1</u>
Set II - Wounding Agent Data	<u>1</u>
Set III - Wound Tract Data	<u>1</u>
Set IV - Autopsy Supplement	<u>1</u>
Set V - Medical Evaluation and Treatment	<u>1</u>
Set VI - Interview of Casualty	<u>1</u>
Set VII - Interview of Others	<u>1</u>
Set VIII - Burn Supplement	<u>1</u>
Set IX - Body Armor	<u>1</u>
Set XI - Troop Interview	<u>1</u>
<u>Section C</u>	
1. Photographs (or negatives)	<u>17</u>
2. X-Rays	<u>0</u>
3. Recovered Missiles	<u>0</u>
4. Photo Caption Sheet(s)	<u>1</u>
5. Other Exhibits <i>vehicle diagram</i>	<u>1</u>

6 October 1969

BATTLE DAMAGE ASSESSMENT AND REPORTING TEAM

PART I - Case Scenario

SOURCES OF INFORMATION

TC
(Job Title or Position of Person Interviewed)

CASE # ABD-02-70002-00

(Job Title or Position of Person Interviewed)

TEAM MEMBER SFC GIFT

(Job Title or Position of Person Interviewed)

DATE 7 JAN 70

 SITREP

X INSUM

 AFTER ACTION REPORT

(Other Source of Information)

(Other Source of Information)

1. Service involved: X Army Navy Marines Air Force

2. Type Equipment:

<u> </u> M113 APC	<u> </u> 1/4 T Trk	<u> </u> 105 Howitzer	<u> </u> Aircraft
<u> </u> M551	<u> </u> 3/4 T Trk	<u> </u> 155 Howitzer	(Specify)
<u>X</u> M48 Tank	<u> </u> 2-1/2 T Trk	<u> </u> 8" Howitzer	<u> </u>
<u> </u> M88 VTR	<u> </u> Other	<u> </u> 175mm Gun	<u> </u>
<u> </u> M106 Mortar Carrier	<u> </u>	<u> </u> 40mm "Duster"	<u> </u>
<u> </u> M577 CP	<u> </u>	<u> </u> Towed	<u> </u>
<u> </u> M548 Cargo	<u> </u>	<u> </u> SP	<u> </u>
<u> </u> Other	<u> </u>	<u> </u> Other	<u> </u>

3. Federal Stock Number 2350-895-9154

4. USA Serial, Hull, or Tail Number USA 07A91069 M22

5. Unit Identification: a. M CO 3/11TH ACR

b. APO 96257 c. CTZ I II (III) IV

6. Date/Time Group: a. Start of Mission 050815 JAN 70

b. End of Mission 051825 JAN 70

c. Of Incident 051825 JAN 70

CASE # ABD-02-70002-00

7. Location of Incident: a. UTM Coordinates XT 583833
b. Geographical Name AN LOC
c. Map Sheet Number 6332 III Series 27014
8. Name of Operation or Mission Number UNK

Brief description of maneuver during engagement, if possible, and remarks (sketch map oriented to north, time oriented, and direction of movement). Use Set 6 or reverse side of this page.

9. Equipment mileage or hour reading: a. Odometer or ~~hour~~ reading 912 MILES
b. Mission mileage or time estimate 10 MINUTES
10. Has this incident been reported by other means ? Yes ? No ✓ Unknown
11. If so, describe or identify report(s) COLED-V
12. Size of friendly force: a. ? Squad b. ✓ Platoon c. ? Company
d. ? Battalion e. ? Brigade f. ? Other (Specify)
13. Size of enemy force: a. ? 0-14 b. ? 15-60 c. ? 61-250 d. ? 251-700
N/A e. ? 700-1500 f. ? 1501-3500 g. ? Over 3500
14. Type of enemy force: ? VC ? NVA ? Other N/A
15. Estimated range in meters between forces at start of engagement:
a. ? 0-25 b. ? 25-50 c. ? 50-100 d. ? 100-150 e. ? 150-200
f. ? 200-300 g. ? Over 300 (Specify) N/A
16. Type mission: a. ? Search & Destroy b. ? Recon c. ? Photo
d. ? Clearing e. ? Ambush f. ✓ Securing g. ? Combat Patrol
h. ? Inactive i. ? Recon In Force j. ? Other (Specify)
17. Deployment: a. ✓ Road March b. ? Covering c. ? Base Camp Defense
d. ? Landing e. ? Other (Specify)

18. Terrain Contour: a. ☐ Mountainous b. ☐ Hilly c. ☐ Gently Rolling
d. ☒ Level e. ☐ Other (Specify) _____
19. Vegetation Type: a. ☒ Jungle b. ☐ Clear Forest c. ☐ Brush d. ☐ High grass
e. ☐ Tropical Swamp Forest f. ☐ Plantation
g. ☐ Cultivated Area h. ☐ Marsh i. ☐ Swamp
j. ☐ Paddy k. ☐ Other (Specify) _____
20. Soil Type: a. ☐ Sandy b. ☒ Silt c. ☐ Clay d. ☐ Gravel e. ☐ Other (Specify) _____
21. Soil Condition: ☐ Wet ☒ Dry
22. Equipment Speed: Was equipment moving when hit: ☒ Yes ☐ No
a. If moving, how fast 10-15 MPH
b. If speed was limited, Why? (1) ☐ Terrain
(2) ☐ Other than Terrain
(3) ☐ Explain _____
23. Weather information:
a. Type: ☐ Rain ☐ Fog ☒ Clear ☐ Overcast ☐ Other (Specify) _____
b. Temperature: 80-82 °F c. Wind Velocity UNK
c. Wind Direction UNK e. Barometer reading UNK
f. Relative Humidity LOW
24. Visibility: a. Cloud Cover ☐ Yes ☒ No b. Height UNK feet
c. Visible Range UNLIMITED d. If Night: ☐ Full Moon
☐ Half Moon ☐ Quarter Moon ☐ Star-light ☐ Artificial illumination (Specify Type) _____
25. Direction of attack: a. ☐ Frontal b. ☐ Left Flank c. ☐ Right Flank
d. ☐ Rear e. ☐ Other (Specify) LINE OF SIGHT
26. Was enemy detected before he engaged? ☐ Yes ☐ No N/A

27. How soon after sighting enemy did firing commence: a. Immediately
 b. Did not return fire c. Other (Specify) N/A
28. Who fired first: a. Friendly b. Enemy c. Unknown N/A
29. Intensity of enemy fire: a. Light (1-10) b. Moderate (10-25)
 c. Heavy (Over 25) d. Comments N/A
30. Was cover and concealment used by friendly forces for personnel and/or equipment Yes No If yes, how? N/A
31. What unused sources of cover and concealment were available: N/A
32. Acquisition Information: N/A
- a. How was enemy detected: Sight Hearing Sensor Device (Specify)
- b. What sensor (or sensor characteristics) would have detected the enemy earlier
- c. How accurate was fix on enemy firing positions: 10 meters 25 meters
50 meters 100 meters Over 100 meters
- d. How was fix determined?
- e. How long did it take you (or other crew members) to locate specific targets?
- f. If night, was night observation device used? Yes No
- g. If yes, specify type?
33. Aircraft: a. Altitude b. Dive angle used
 c. Airspeed knots d. Evasive action used
 e. Type weapons carried or delivered
 f. Type formation during flight

CASE # ABD-02-70002-00

g. Escort aircraft ☐ Yes ☐ No If yes, list below:

TYPE

NUMBER

MODEL

Rotary Wing

Fixed Wing

h. Ground Fire Information: *N/A*

(1) Was firing source observed? ☐ Yes ☐ No

(2) Aircraft heading _____ degrees

(3) Direction of source from aircraft (o'clock) _____

(4) Source: Identified ☐ Yes ☐ No Attacked ☐ Yes ☐ No

If identified, what (type weapons)? _____

PART II - EQUIPMENT DAMAGE

1. Equipment was ☒ Damaged ☐ Destroyed *Battle loss*
2. Equipment was damaged or destroyed by: *warped hull.*
- a. ☐ Direct Fire e. ☐ AA Fire
- b. ☐ Indirect Fire f. ☐ Accident (combat oriented)
- c. ☒ Mines g. ☐ Other (Specify) _____
- d. ☐ Missiles
3. What was mission of equipment? *SECURING mine sweep team*
4. Number of hits for which collected data is described below? *1*

Hit Number	1	2	3	4
a. Weapon/Mine Type & Model	<i>T-46 MINE</i>			
b. Round Size/ mine weight	<i>2.0 lbs</i>	<i>INSUM Reports other mines same size and type found</i>		
c. Round Type (AP, HE, Etc.)	<i>HE</i>	<i>in immediate area</i>		
d. Fuze type/ Identification: (airburst, ground-burst)	<i>PRESSURE PLATE</i>			
e. Estimates of where fuze functioned	<i>ON CONTACT</i>			
f. Range of weapon to target (in meters)	<i>0</i>			
g. Hit location (Station No., Frame #, General Description)	<i>Right side FIRST ROAD wheel</i>			
h. Attack angle of projectile to equipment				
Azimuth	<i>90</i>			
Elevation	<i>-90°</i>			

CASE # ABD-02-70002-00

- i. Damaged major parts engine transmission transfer case
Suspension system Drive train Fire Controls Main Armament
Communications equipment Radiator Wheels Other (Specify) 4.11

Hit Number	1	2	3	4
j. Depth of Penetration (in inches)	N/A			
k. Did round perforate	Yes/No	Yes/No	Yes/No	Yes/No
l. If Yes continue Dimensions & Shape of hole at entrance and exit	N/A			
m. Did spall occur	N/A			
n. Effects of spall on personnel and components	N/A			
o. Path of penetrator/perforation in equipment	N/A			

FIRE DAMAGE

5. Did a fire occur? Yes No
6. Cause of fire: Mine Direct fire weapon Indirect fire
Other (explain) N/A
7. Location of fire damage N/A
8. Damage caused by fire N/A

FIRE DAMAGE (Continued)

9. Level of Fuel (at time of incident): a. 1/4 b. 1/2 c. 3/4 d. Full
10. Material supporting combustion: a. Gasoline b. Diesel c. Ammo
11. Was fire suppression equipment available? Yes No
12. Was there time to operate fire suppression equipment? Yes No
13. Was the fire suppression equipment used? Yes No
14. What type of fire suppression equipment was used Installed Portable
Other (Specify) _____
15. Was the fire suppression equipment effective Yes No
16. Was there time to evacuate? Yes No
17. Did the crew evacuate? Driver Vch Comdr Gunner Loader
Pilot Lt Seat Pilot Rt Seat
Yes No Yes No Yes No Yes No
- Others (crew members only) _____
Yes No Yes No Yes No Yes No

EXPLOSION DAMAGE (On or within vehicle)

18. Did an internal explosion occur? Yes No Unknown
as a result of fire Yes No
19. Was explosion Immediate Delayed. If delayed, how long _____
20. What was the cause of the explosion? Ammo Duel Other (Specify) _____
21. Damage caused by the explosion: _____

BLAST DAMAGE

22. Was equipment damaged by an external blast? Yes No
23. What was the distance from blast to equipment (in meters)? a. 0-10
b. 10-20 c. 20-30 d. Over 30 e. Other (specify) _____
24. Was equipment moved by the blast? Yes No If yes, how far? 2 FT
25. Was equipment overturned by the blast? Yes No
26. Was equipment damaged by fragments due to the blast? Yes No

BLAST DAMAGE (Continued)

27. Other damage caused by the blast BLEW OFF 1st ROAD WHEEL
Knocked 1st Road wheel Arm Housing loose from

28. Describe fragment damage (if not covered elsewhere in form) N/A

29. Were doors or hatches open on equipment when damaged? ☒ Yes ☐ No

27 cont'd: Hull ^{4cm} 2d Road wheel Arm Housing separated
 FROM Hull ^{2cm} Coil spring Housing Damaged 2d Coil
 spring blown off. SHOCK ARM blown OFF FROM
 2d Road wheel. 1st SHOCK ARM bent.

PART III - PERSONNEL INJURED

1. Number of casualties (crew members only) 1 None KIA WIA DOW
 MIA NBI IRHA

2. CASUALTY

	Driver Pilot Lt Seat	Veh Comdr Pilot Rt Seat	Gunner	Loader	Other Specify
a. Hit Number					
b. Casualty was KIA, WIA, MIA or DOW					
c. Location of wound (head, neck, hand, torso, etc.)					
d. To what extent did each wounded perform his mission					
e. Where was casualty's assigned station					
f. Was casualty at his assigned station (YES or NO) If not, where was he					
g. Was casualty evac- uated (YES or NO) If yes, by whom If yes, when					
h. Was casualty wearing protective clothing If yes, specify type of protective cloth- ing, i.e. body armor, flak jacket, etc.					
i. Did protective cloth- ing prevent injury or reduce injury					
j. What caused casualty (1) Penetrator (2) Fragment (3) Blast (4) Shock (5) Other (Specify Other)					

CASE # ABD-02-70002-00

3. Number of casualties (Passengers Only) ☒ None ☐ KIA ☐ WIA ☐ MIA
☐ DOW ☐ NBI ☐ IRHA

PART IV - OPERATIONAL DATA

1. Was equipment and/or major components operating when damaged?
- ☒
- Yes
- ☐
- No

Check equipment or Components	Operating when damaged		Continued to operate		Remaining Capability (time related)	If shut down why?
	YES	NO	YES	NO		
<input type="checkbox"/> Engine						
<input type="checkbox"/> Transmission						
<input type="checkbox"/> Transfer case						
<input type="checkbox"/> Frame						
<input checked="" type="checkbox"/> Suspension	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>		See page 91
<input type="checkbox"/> Drive Train						
<input type="checkbox"/> Fire Controls						
<input type="checkbox"/> Main Armament						
<input type="checkbox"/> Communication Equipment						
<input type="checkbox"/> Radiator						
<input checked="" type="checkbox"/> Wheels	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>		
<input type="checkbox"/> Other (Specify)						

2. Was damaged equipment subsequently destroyed by friendly forces?
- ☐
- Yes
- ☒
- No

3. If equipment was damaged and had to be destroyed by friendly forces, was it used to aid in mission prior to destruction?
- ☐
- Yes
- ☐
- No
- N/A*

4. If yes, how?
- N/A*

5. Was damaged equipment repaired in field before mission was completed?
-
- ☐
- Yes
- ☒
- No If yes, estimate repair time (man hours) _____

6. Was equipment able to return to base or retreat to a safe location under its own power?
- ☐
- Yes
- ☒
- No If no, how retrieved
- M 88 TOWED*

NOT REPRODUCIBLE

CASE # ABD-02-70003-00

7. Was standard "on vehicle equipment" (OVE) in place on vehicle? ☒ Yes ☐ No
If no, where was it located? _____
8. What was composition and location of cargo? NONE CARRIED

9. What additional items were on/or in the damaged equipment? PERSONAL GEAR

10. Action of the equipment after receiving the hit:
Ground vehicle/equipment reaction to hit:
a. ☐ Continued its activity in an operable state.
b. ☒ Discontinued activity but remained in operable state.
c. ☐ Was rendered inoperable
d. ☐ Scrapped
~~Aircraft Reaction to hit: N/A~~
e. ☐ Continued to fly; mission completed.
f. ☐ Continued to fly; mission not completed, flew _____ minutes.
g. ☐ Forced to land; inspection/quick fix/took off
h. ☐ Forced to land; later destroyed
i. ☐ Forced to land; later recovered
j. ☐ Crashed; aircraft recovered
k. ☐ Crashed; aircraft not recovered
11. Is equipment repairable: ☒ Yes ☐ No If repairable, at what echelon?
a. ☐ Organizational b. ☐ DS Unit c. ☐ GS Unit d. ☐ Depot
e. ☒ CONUS f. ☐ Other (Specify) Will be worked a little
12. Estimate total down time for repairs (man hours) UNK

NOT REPRODUCIBLE

CASE # ABD-02-20002-00

PART V - PERSONAL INTERVIEW

NAME/RANK WEBER, Joseph C E-6 SSAN 434-44-5387

UNIT 1st Co 3rd ACR

1. Responsibility of person interviewed? TRACK Commander
2. Location of person interviewed at time of impact (relative to equipment damaged) TC Hatch
3. Activity of person interviewed at time of impact Riding
4. Was the person interviewed wounded or injured as result of impact NO
5. Activity of the equipment at the time it was hit MOVING DOWN ROAD
6. What type of protection is inherent at point of damage NORMAL
ARMOR
7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred NO
8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred NO
9. Would any equipment modification reduce the degree of damage NO
10. Approximate distance from: a. Weapon to equipment _____ meters
b. Detonation of munition to equipment 0 meter
11. What type of damage did the equipment receive? (Fire, explosion, missile, impregnation, etc.) MINIE BLAST
12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? Yes NO Explain BECAUSE OF GROUND CONDITIONS
HAD A BETTER MINE
13. Could damage have been prevented? Yes NO How SWEEP OPERATION
14. Was the answer to above based on definite knowledge Yes, possible knowledge _____, or no knowledge _____.
15. Does damage present a secondary hazard to personnel? Yes NO If yes, explain _____

NOT REPRODUCIBLE

M-22.

PART VI - SKETCH

NAME/RANK WEISER Joseph C E 6
LAST, FIRST MI RANK

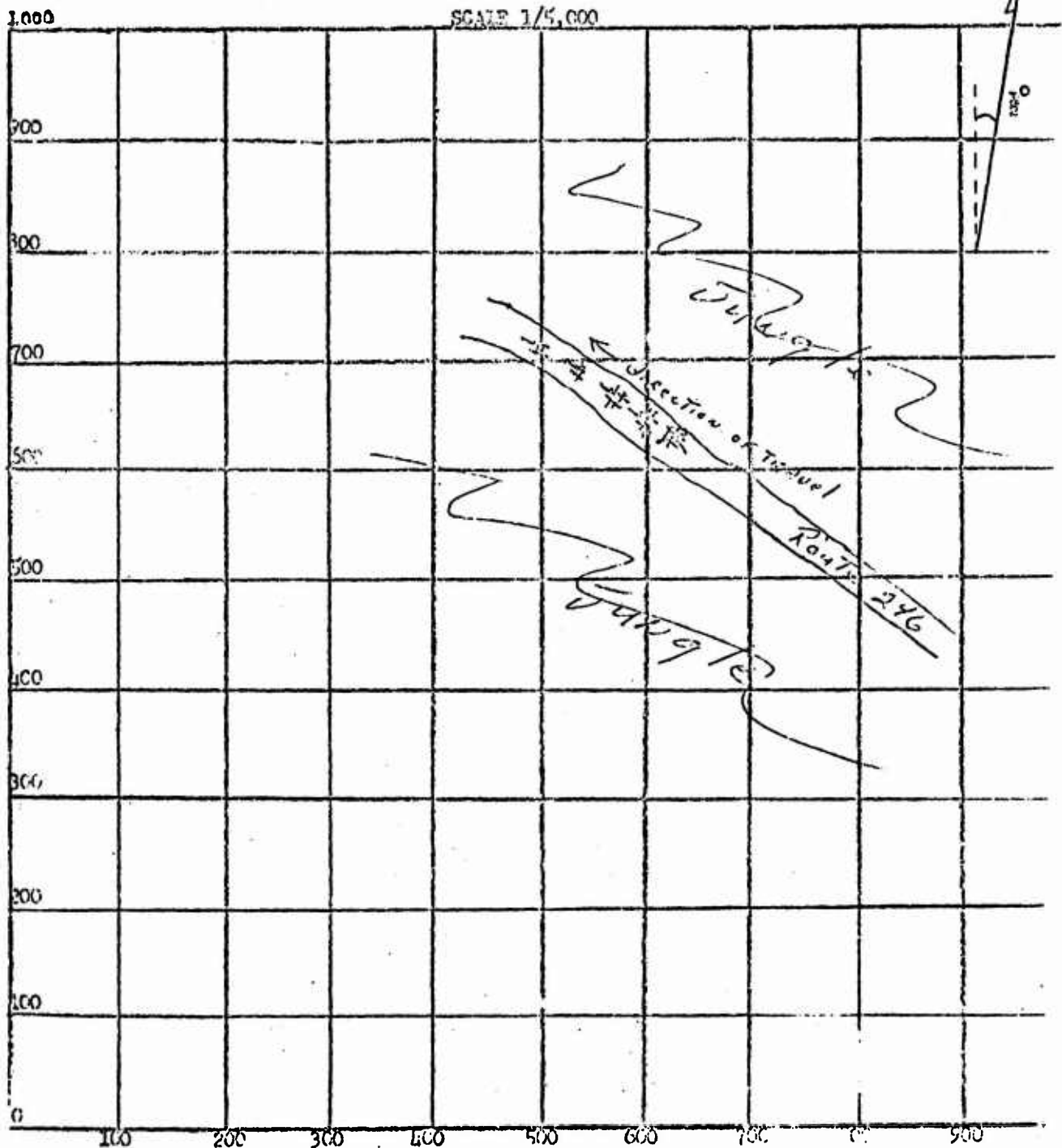
CASE NO. AFD-02-70002-00

SSN: 434445387

INTERVIEWER SFC G. J. P.

UNIT: IN CO. 3/11 ACIR

COORDINATES: XT 583833



NOT REPRODUCIBLE

NETS 87

M-22

CASE # ABD-02-70003-CX

PART V - PERSONAL INTERVIEW

NAME/RANK MADING, LAWRENCE L E-5 SSAN 572-60-7999

UNIT M Co 3/11th ACR

1. Responsibility of person interviewed? DRIVER
2. Location of person interviewed at time of impact (relative to equipment damaged) DRIVER'S SEAT
3. Activity of person interviewed at time of impact DRIVING
4. Was the person interviewed wounded or injured as result of impact NO
5. Activity of the equipment at the time it was hit MOVING DOWN ROAD
6. What type of protection is inherent at point of damage APR 4.4.4
ARMOR
7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred NO
8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred NO
9. Would any equipment modification reduce the degree of damage NO
10. Approximate distance from: a. Weapon to equipment _____ meters
b. Detonation of munition to equipment C meter
11. What type of damage did the equipment receive? (Fire, explosion, missile, impregnation, etc.) MINC BLAST
12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? Yes No Explain GROUND WAS HARD + BLAST WENT STRAIGHT UP.
13. Could damage have been prevented? Yes No How BETTER SWEEP OF ROAD
14. Was the answer to above based on definite knowledge ✓, possible knowledge _____, or no knowledge _____.
15. Does damage present a secondary hazard to personnel? Yes No If yes, explain _____

NOT REPRODUCIBLE

M-22

CASE # ABD-02-7003-001

PART V - PERSONAL INTERVIEW

NAME/RANK MEIKS, DENNIS E PFC SSAN 520-50-8478

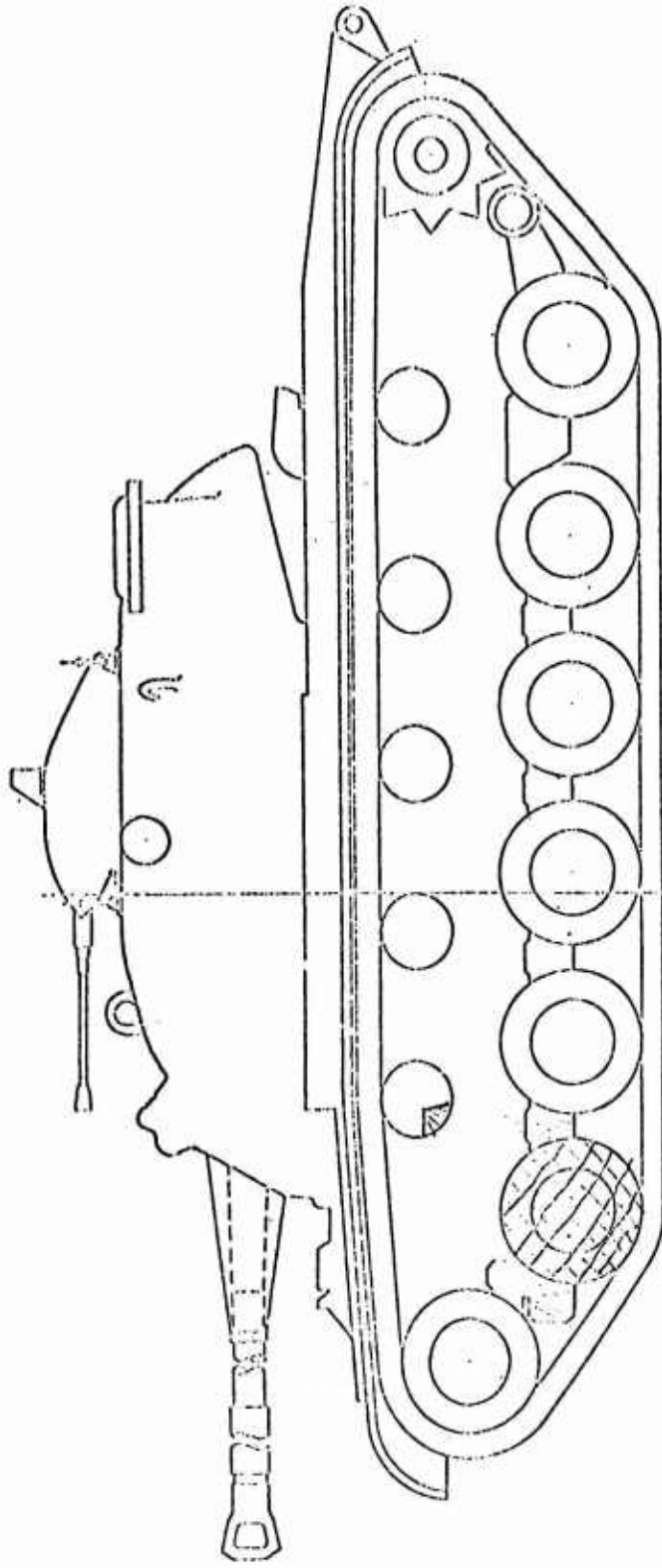
UNIT A1 Co 3/11th ACR

1. Responsibility of person interviewed? GUNNER
2. Location of person interviewed at time of impact (relative to equipment damaged) LOADERS MATCH
3. Activity of person interviewed at time of impact Riding
4. Was the person interviewed wounded or injured as result of impact NO
5. Activity of the equipment at the time it was hit moving down road
6. What type of protection is inherent at point of damage NORMAL
PROT
7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred NO
8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred NO
9. Would any equipment modification reduce the degree of damage NO
10. Approximate distance from: a. Weapon to equipment _____ meters
b. Detonation of munition to equipment 5 meter
11. What type of damage did the equipment receive? (Fire, explosion, missile, impregnation, etc.) missile blast
12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? Yes No Explain due to HARD Ground
13. Could damage have been prevented? Yes No How _____
14. Was the answer to above based on definite knowledge ✓, possible knowledge _____, or no knowledge _____.
15. Does damage present a secondary hazard to personnel? Yes No If yes, explain _____

NOT REPRODUCIBLE

ALB 02-70002-00

90



Right Side

8 Tanks

NOT REPRODUCIBLE

DESTROYED
DIA 16:0

FILM CAPTION DATA

CASE NO. ABD- 00110000-00

ROLL/PACK NO. 30	FILM TYPE: 135 Black and White	DATE: 7 Jan 70
Location of Photo Coverage Camp 101		
Photographer: G. J. Penson	Camera Number 12261	Lens Number 50mm
Frame No.	CAPTION	
1	Intro.	
2	Front view	
3	Rear view	
4	Right side	
5	Left side	
6	Right front	
7	11 road wheel gun mounting bracket blown away from hull--4, on	
8	Side view of mounting bracket	
9	11 road wheel and hub blown off --side view	
10	" " Rear view	
11	" " Front view	
12	Turret rotating clockwise	
13	Side view of 12 road wheel gun mounting bracket separated from hull--2 on	
14	12 shot: obscuring missing	
15	11 gun port roller damaged--side view	
16	" " Rear view	
17	" " Front view	

NOT REPRODUCIBLE

APPENDIX B

DRAFT PROPOSED MATERIEL NEED (1DPMN)

Army Countermine Mobility Equipment System (ACMES)

18 July 1971

**US Army Mobility Equipment Research & Development Center
Fort Belvoir, Virginia**

I. NEED

There is a need for mobility equipment that has a high resistance to loss of mobility after a mine encounter. It is particularly desirable to decrease the single-hit, mobility kill vulnerability of combat armored vehicles such as the M-48, M-60, M-113, and M-551. This need is supported by data from the Battle Damage Assessment Reporting Program (BDARP) presented in Appendix A.

This proposed materiel need does not envision basic design of the vehicle at this time but is directed more to the development of accessories and retro-fit kits that are suitable for application to vehicles in the current inventory. Such kits should be compatible with the improved mine detection subsystems that will be available in the same near term.

It should be emphasized that mines are highly cost effective from the threat standpoint and that the means to counter the mine threat must then also be cost effective.

II. JUSTIFICATION

a. Threat

The use of mines by current and potential threats against mobility equipment such as tanks and armored personnel carriers is increasingly cost effective from the enemy viewpoint. This condition arises from the fact that a relatively small explosive charge set off by either contact, delay, influence, or command will almost certainly break the vehicle track and thus inflict a mobility kill. It is also almost a certainty that additional mobility damage will tend to be limited in most cases to the first and/or second road wheels of the vehicle while the engine, power train, weapons, and crew are generally intact. Thus, in spite of the relatively minor structural damage that is incurred, the critical

function of mobility is lost, and the vehicle becomes easy prey to a variety of subsequent enemy options while the mobility mission itself is lost. It is recognized that the science of mine detection is improving but the countermine effort should maintain a balanced effort by continuous and critical examination of the vehicle itself. By this concept the detection subsystem and vehicle subsystem become a countermine vehicle system with mutual enhancement.

b. This draft proposed materiel need takes the position that the almost certain loss of mobility incurred by tanks and armored personnel carriers after a single mine encounter constitutes a serious operational deficiency. This growing degradation of capability has encouraged and stimulated and will continue to encourage and stimulate the use of mines to impair and destroy mobility missions. There is a need for a broad variety of flexible countermine materiel quite separate and distinct from improved vehicles and detection per se. It is desirable that the current operational deficiency be overcome by providing commanders with a variety of materiel options so that countermine efforts may be selected to match the threat.

III. OPERATIONAL CONCEPT

It is postulated that the operational deficiency be countered by providing the field commander with materiel that will significantly increase or maintain mobility after encounter with a mine. Usage of such materiel would be intermittent rather than continuous and consistent with the magnitude of the mine threat.

It is recognized that deployment of a countermeasure eventually forces the enemy to also deploy a counter-countermeasure, but the subject materiel should have sufficient versatility to counter a broad variety of potential threats.

IV. ORGANIZATIONAL CONCEPT

V. LOGISTICAL CONCEPT

VI. CHARACTERISTICS

a. Performance

1. The system shall not degrade mobility of the vehicle to which it is applied by more than 20% or otherwise impair or degrade the critical functions of the vehicle before a mine encounter.

2. After the loss of a track and the corresponding front two road wheels of the vehicle, the system shall have mobility at least 10% of the original mobility and

shall be otherwise suitable for either unassisted return to base or continuation of the mission.

b. Physical Characteristics

Generally, the physical characteristics of this subsystem should be consistent and compatible with a specific mobility vehicle system. Factors such as weight, volume, ruggedness, transportability, configuration, maintenance characteristics, integrated logistics support, and personnel will require further attention and definition during development.